PB-213 557

NEW YORK SOLID WASTE MANAGEMENT PLAN

New York State Department of Health

Prepared for:

Environmental Protection Agency

1971

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 213 557

SOLID WASTE MANAGEMENT PLAN

NEW YORK

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

status report 1970

SOLID WASTE MANAGEMENT PLANNING S
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEM
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
ANAGEMENT PLANNING SOLID WASTE MA
ENT PLANNING SOLID WASTE MANAGEME
NAGEMENT PLANNING SOLID WASTE MA

NEW YORK

Solid Waste Management Plan

Status Report 1970

This report (SW-5tsg) was prepared
by ROY F. WESTON, ENVIRONMENTAL SCIENTISTS AND ENGINEERS
for the New York State Department of Health
under State planning grant (UI-00021)
from the Federal solid waste management program

U.S. ENVIRONMENTAL PROTECTION AGENCY
1971

An environmental protection publication
in the solid waste management series (SW-5tsg)

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 · Price $4.75
STOCK NUMBER 5502-0045

FOREWORD

TO ENCOURAGE SYSTEMATIC PLANNING for better management of the Nation's solid wastes, Congress in the 1965 Solid Waste Disposal Act provided grant monies for the States for solid waste planning.[1] By June 1966, fourteen States had met the stipulations of the Act and had embarked upon the planning process with the help of the Federal funds. Today, almost every State has applied for and received a solid waste planning grant.[2] From each of the grants the Federal government expects two practical results: first, a plan (and report) for the State's management of its solid wastes; second, development of an agency for the managing function.[3]

The present document publishes the first phase of the New York State solid waste management planning program, developed by the State under a Federal solid waste management planning grant that went into effect June 1, 1966. The report identifies the overall solid waste problem and establishes a framework for State action to ensure efficient and effective management practices. But, the planning process is dynamic; future revision will be an important part of the process to take account of changing conditions and better data. Moreover, a plan is not an end in itself. Its formulation is the key to action: to legislation, standards, technical assistance, public relations, and enforcement.

---

[1] The Solid Waste Disposal Act as amended; Title II of Public Law 89-272, 89th Cong., S.306, October 20, 1965; Public Law 91-512, 91st Cong., H.R.11833, October 26, 1970. Washington, U.S. Government Printing Office, 1971. 14 p.

[2] Toftner, R. O., D. D. Swavely, W. T. Dehn, and B. L. Sweeney, comps. State solid waste planning grants, agencies, and progress--1970; report of activities through June 30, 1970. Public Health Service Publication No. 2109. Washington, U.S. Government Printing Office, 1971. 26 p.

[3] Toftner, R. O. Developing a state solid waste management plan. Public Health Service Publication No. 2031. Washington, U.S. Government Printing Office, 1970. 50 p.

Besides providing the State solid waste management agency with a guide for action, the State plan will help to guide local and regional solid waste planning and subsequent implementation. The plan can also provide support for improved State legislation related to solid waste management.

New York's plan is designed, therefore, to: (1) begin the planning process; (2) establish policies and procedures to guide the State solid waste agency, formerly, the Department of Health and now the Department of Environmental Conservation; (3) guide regional planning; (4) provide both a documented base for improved solid waste legislation and operating regulations and a summary of objectives and goals. With these objectives in mind, this plan report presents and analyzes pertinent solid waste data, identifies problems indicated by the data, sets objectives that if achieved would solve identified problems, and finally, proposes immediate, intermediate, and long-range measures for achieving objectives. This plan should thus provide the New York State Department of Health with an invaluable management tool with which to begin solving the State's solid waste management problems.

--RICHARD D. VAUGHAN
Deputy Assistant Administrator
for Solid Waste Management

TABLE OF CONTENTS

Page

LIST OF TABLES AND FIGURES

LIST OF MAPS

SUMMARY

PART I: THE NEW YORK STATE SOLID WASTE PROGRAM

Chapter One: The Current Solid Waste Program in New York State

INTRODUCTION 1-1
STATE OBJECTIVES 1-2
STRATEGY 1-2
PRESENT PLANNING ACTIVITIES 1-3
NATIONAL SURVEY 1-3
PUBLIC INFORMATION 1-4
ENFORCEMENT 1-4
PURE WATERS AUTHORITY 1-4

Chapter Two: Approach to Statewide Solid Waste Planning

SELECTION OF STATE ROLE 2-1
ORGANIZING FOR MANAGEMENT 2-2
THE SOLID WASTE MANAGEMENT PROGRAM 2-3
DEVELOPMENT OF THE PLAN OF IMPLEMENTATION 2-4

Chapter Three: Objectives and Scope of Study

DATA COLLECTION 3-2
DATA ANALYSIS AND INTERPRETATION 3-2
THE STATE ROLE 3-2
SERVICE AREAS 3-3
PLAN AND PROGRAM 3-3
PUBLIC RELATIONS 3-3

PART II: CONDITIONS AFFECTING THE SOLID WASTE PROBLEM

Chapter Four: Background and Outline

INTRODUCTION 4-1
POPULATION AND DEVELOPMENT PATTERNS 4-1
INDUSTRIAL AND AGRICULTURAL DEVELOPMENT 4-2

TABLE OF CONTENTS
(continued)

Page

TRANSPORTATION 4-2
PHYSICAL AND NATURAL CONDITIONS 4-2
STATE AGENCIES AND LEGISLATION 4-3
POLITICAL, SOCIOLOGICAL, AND FINANCIAL FACTORS 4-3

Chapter Five: Population Growth and Development Patterns

INTRODUCTION 5-1
HISTORIC DEVELOPMENT AND POPULATION GROWTH 5-1
LAND USE AND ZONING CONTROLS 5-3
CURRENT STATE-WIDE DEVELOPMENT ACTIVITY 5-4
  CENTERS OF DEVELOPMENT ACTIVITY 5-4
  POPULATION GROWTH AND CHANGE BY ECONOMIC DEVELOPMENT AREAS 5-6
SUMMARY OF TRENDS 5-12

Chapter Six: Industrial and Agricultural Activity

INTRODUCTION 6-1
EXISTING AND FUTURE INDUSTRIAL EMPLOYMENT AND AGRICULTURAL ACTIVITY 6-1
SUMMARY OF MANUFACTURING TRENDS 6-11
SUMMARY OF AGRICULTURAL TRENDS 6-14

Chapter Seven: Transportation

INTRODUCTION 7-1
HISTORIC DEVELOPMENT 7-1
SYSTEMS, METHODS AND PRACTICES 7-2
  HIGHWAYS 7-3
  RAILROADS 7-6
  CANALS AND WATERWAYS 7-8
ULTIMATE SYSTEM CAPABILITIES AND LIMITATIONS 7-11

Chapter Eight: Physical and Natural Conditions

INTRODUCTION 8-1
GEOLOGICAL FACTORS 8-1
TOPOGRAPHICAL FACTORS 8-2
HYDROLOGICAL FACTORS 8-3
METEOROLOGICAL FACTORS 8-3
OUTLINE OF PHYSICAL AND NATURAL CONDITIONS IN NEW YORK STATE 8-4
PHYSIOGRAPHIC PROVINCES 8-4
SUMMARY 8-9

TABLE OF CONTENTS
(continued)

Page

Chapter Nine: State Agencies and Legislation

INTRODUCTION 9-1
EXISTING LEGISLATION AND LAWS 9-1
STATE AGENCIES 9-4
STATE AGENCIES - SUMMARY 9-7
CURRENT RESPONSIBILITIES - LOCAL AND STATE 9-8
ENFORCEMENT AND CONTROL 9-9

Chapter Ten: Political, Sociological, and Financial Factors

INTRODUCTION 10-1
POLITICAL AND SOCIOLOGICAL CONSIDERATIONS 10-1
INTERMUNICIPAL COOPERATION 10-4
ECONOMIC AND FINANCIAL FACTORS 10-6

PART III: INVENTORY, ANALYSIS, AND DEVELOPMENT OF DATA

Introduction
Data Requirements
Existing Facilities and Land Disposal Sites
Waste Production
Special Wastes
Supplemental Data Requirements

Chapter Eleven: Data Requirements and Sources

INTRODUCTION 11-1
DATA SOURCES 11-2
DATA REQUIREMENTS 11-2
  WASTE PRODUCTION 11-2
  SITES AND FACILITIES 11-3
  SPECIAL WASTES 11-4
  COSTS 11-4

Chapter Twelve: Existing Facilities and Land Disposal Sites

GENERAL 12-1
LAND DISPOSAL SITES 12-1
  CHARACTERISTICS OF LAND DISPOSAL SITES 12-2
  CAPACITIES OF LAND DISPOSAL SITES 12-3
FACILITIES 12-4
  INCINERATORS 12-4
  OTHER FACILITIES 12-5

TABLE OF CONTENTS
(continued)

Page

COSTS 12-5
  LAND DISPOSAL SITES 12-5
  INCINERATORS 12-6
  TRANSFER STATIONS 12-7
REFERENCES 12-8

Chapter Thirteen: Municipal Wastes

DATA TYPES AND SOURCES 13-1
PER CAPITA MUNICIPAL WASTE COLLECTION 13-2
WASTE COLLECTION RATE TRENDS 13-5
POPULATION AND PROJECTIONS 13-7
EXISTING AND PROJECTED WASTES 13-8
REFERENCES 13-10

Chapter Fourteen: Industrial Wastes

APPROACH TO WASTE QUANTITY DETERMINATION 14-1
UNIT WASTE PRODUCTION 14-2
EXISTING AND PROJECTED EMPLOYMENT 14-4
EXISTING AND PROJECTED INDUSTRIAL WASTES 14-5
REFERENCES 14-7

Chapter Fifteen: Agricultural Wastes

EXISTING AND PROJECTED AGRICULTURAL ACTIVITIES 15-2
EXISTING AND PROJECTED AGRICULTURAL WASTES 15-3
REFERENCES 15-6

Chapter Sixteen: Special Wastes

GENERAL 16-1
SOURCES, QUANTITIES, AND CURRENT DISPOSAL PRACTICES 16-1
RADIOACTIVE WASTES 16-1
MINING WASTES 16-3
DREDGINGS 16-3
INDUSTRIAL SPECIAL WASTES 16-4
MUNICIPAL WASTEWATER SLUDGES 16-5
WASTE TREATMENT SLUDGES 16-6
SITE AND FACILITY RATING 16-7
SITE AND FACILITY MODIFICATION 16-7

TABLE OF CONTENTS
(continued)

Page

Chapter Seventeen: Supplemental Data Requirements

APPROACH TO FUTURE STUDIES 17-1
GENERAL DATA REQUIREMENTS 17-2
PLANNING DATA NEEDS 17-2
COLLECTION PROCEDURES 17-4
WASTE QUANTITY INFORMATION 17-5
PROPOSED SYSTEM OF NOMENCLATURE AND CLASSIFICATION OF REFUSE 17-7
EXISTING FACILITIES AND LAND DISPOSAL SITES 17-9
FACILITY COST RELATIONSHIPS 17-11
SUMMARY 17-12

PART IV: ELEMENTS OF A STATEWIDE SOLUTION

Chapter Eighteen: Site Reuse

INTRODUCTION 18-1
SITE REUSE IN PERSPECTIVE 18-1
REUSE FACTORS AND CONSIDERATIONS 18-3
  EXISTING AND FUTURE LAND USE 18-4
  GEOLOGY, HYDROLOGY, TOPOGRAPHY, AND SOILS 18-4
  DESIRED ULTIMATE USE 18-4
  OTHER FACTORS 18-5
ULTIMATE USE ALTERNATIVES 18-5
  RECREATION 18-6
  RESIDENTIAL 18-6
  COMMERCIAL 18-7
  INDUSTRIAL 18-7
  OTHER USES 18-7
ILLUSTRATION OF SITE REUSE 18-8
  REGIONAL LOCATION AND DEVELOPMENT 18-8
  THE EXISTING SITE 18-9
  CONCEPT OF PROPOSED REUSE 18-10
  ULTIMATE REUSE PLAN 18-13

Chapter Nineteen: Service Areas

INTRODUCTION 19-1
ADVANTAGES OF A REGIONAL APPROACH 19-1
CRITERIA FOR SERVICE AREA DEFINITION 19-3
DELINEATION OF SERVICE AREAS 19-5
FUTURE IMPACT OF SOLID WASTES 19-6

TABLE OF CONTENTS
(continued)

Page

Chapter Twenty: Role of the State

ALTERNATIVE ROLES 20-2
RECOMMENDED ROLE OF THE STATE 20-3

PART V: NEW YORK STATE PLAN AND PROGRAM

Chapter Twenty-One: Plan and Program

INTRODUCTION 21-1
BASIS FOR THE PLAN AND PROGRAM 21-1
THE DYNAMIC PLANNING CONCEPT - A REVIEW 21-2
NEW YORK STATE OBJECTIVES, GOALS, AND TASKS 21-3

MAPS

LIST OF TABLES AND FIGURES

CHAPTER FIVE

Tables

5-1 Total Population Projections by Economic Areas
5-2 Total Population Projections by Counties
5-3 Population Density Projections by Counties

Figures

5-1 Patterns of Development - New York State
5-2 Economic Areas - New York State Dept. of Commerce
5-3 Planning Regions - New York State Office of Planning Coordination
5-4 Population Change - New York State - 1900 to 1995

CHAPTER SIX

Tables

6-1 Total Industrial Employment Projections for Economic Areas
6-2 Agricultural Activity Projections for Economic Areas
6-3 Total Industrial Employment Projections for Counties
6-4 Industrial Employment Density Projections for Counties

Figures

6-1 Change in Industrial Employment and Agricultural Activity by Economic Areas

CHAPTER EIGHT

Figures

8-1 Distribution of Precipitation and Runoff in New York State
8-2 Physiographic Provinces of New York State

LIST OF TABLES AND FIGURES
(continued)

CHAPTER NINE

Figures

9-1 Organization Chart - New York State Department of Health
9-2 Organization Chart - Division of Environmental Health Services
9-3 Health Regions and Districts and Local Full-time Health Departments - New York State Department of Health; July 1, 1968

CHAPTER TWELVE

Tables

12-1 Conditions of Land Disposal Sites - Number of Sites
12-2 Land Disposal Area
12-3 Remaining Land Disposal Site Life
12-4 County-wide Incinerator Data
12-5 Environmental Aspects of Incinerators

Figures

12-1 Existing Landfills - Operating Costs vs. Yearly Tonnage Handled

CHAPTER THIRTEEN

Tables

13-1 Municipal Solid Waste Collection Rates
13-2 Municipal Solid Waste - County Remainder Waste Collection Rates
13-3 Illustrative Table Showing Principal City/Village, County Remainder, and Total County Wastes for Westchester County - 1970
13-4 Existing and Future Total Collected Municipal Wastes by County

Figures

13-1 Unit Municipal Waste Collection vs. Population Density

LIST OF TABLES AND FIGURES
(continued)

CHAPTER FOURTEEN

Tables

14-1 Preliminary Industrial Solid Waste Production Rates
14-2 Industrial Solid Wastes - Comparison of Employment in Primary Metals Group
14-3 Final Industrial Solid Waste Production Rates
14-4 Total Industrial Wastes by County and State

CHAPTER FIFTEEN

Tables

15-1 Agricultural Solid Wastes - Waste Production Rate
15-2 Total Agricultural Wastes by County and State
15-3 Total Wastes from All Sources by County and State

CHAPTER SEVENTEEN

Tables

17-1 Waste Classification System
17-2 Guidelines for Evaluation of Land Disposal Sites

Figures

17-1 Waste Classification System - Effect on Elements of a Waste Management System

CHAPTER NINETEEN

Tables

19-1 Service Areas
19-2 Acreage Requirements to Dispose of Future Municipal and Industrial Solid Wastes by Sanitary Landfill
19-3 Total Operating Costs to Dispose of Future Municipal and Industrial Solid Wastes by Sanitary Landfill
19-4 Total Operating Costs to Dispose of Future Municipal and Industrial Solid Wastes by Incineration
19-5 Selected State Owned Lands - 200 or More Acres
19-6 Projected State Land Requirements for Disposal of Future Solid Wastes

LIST OF MAPS

The maps listed below appear in consecutive order at the end of the volume.

Map Number	Title
1	Population Density - 1970
2	Population Density - 1985
3	Population Density - 1995
4	Industrial Employment Density - 1970
5	Industrial Employment Density - 1985
6	Industrial Employment Density - 1995
7	Transportation Systems
8	Existing Disposal Sites
9	Municipal Waste Density - 1970
10	Municipal Waste Density - 1985
11	Municipal Waste Density - 1995
12	Industrial Waste Density - 1970
13	Industrial Waste Density - 1985
14	Industrial Waste Density - 1995
15	Municipal and Industrial Waste Density - 1970
16	Municipal and Industrial Waste Density - 1985
17	Municipal and Industrial Waste Density - 1995
18	Agricultural Waste Density - 1970
19	Agricultural Waste Density - 1985
20	Agricultural Waste Density - 1995
21	Total Waste Density - 1970

LIST OF MAPS
(continued)

Map Number	Title
22	Total Waste Density - 1985
23	Total Waste Density - 1995
24	Regional Development and Site Location
25	Proposed Landfill Operation
26	Proposed Development - 1975
27	Proposed Development - 1980
28	Proposed Development - 1990
29	Typical Site Sections
30	Proposed Ultimate Development - 1995
31	Service Areas - 1995
32	Service Areas - 1985
33	Municipal and Industrial Waste Density - 1970
34	Selected State Owned Lands

SUMMARY

GENERAL BACKGROUND

Getting rid of solid waste, which was a relatively simple matter not too many years ago, has become a major and complex problem. It is already a significant item in the budget of most communities, generally surpassed only by schools and roads. In the future, the solid waste problem will become bigger, more expensive, and even more complex. In 1995, for example, the solid waste generated in New York State will amount to almost 80 million tons per year if present, well-established trends continue. The cost for disposal of this amount of waste will be between one and four billion dollars per year, depending on the method of disposal. The strictly technical problems of handling and disposal are increasing, largely because of the growing variety and complexity of the solid wastes themselves, which in turn can be attributed to the ever-increasing sophistication and convenience trends of our affluent society. Political considerations and natural conditions further complicate the search for a reasonable solution.

Many communities are running out of or already have used up the land areas suitable for disposal of solid wastes. Thus, they are coming face to face with the situation of scarcity of proper disposal sites, complicated by the reluctance (or even belligerent refusal) of communities to accept solid wastes from other communities for disposal. It is becoming increasingly clear that individual communities acting independently cannot be expected to find the most satisfactory solutions. Action at a higher governmental level is clearly indicated.

THE CURRENT NEW YORK STATE PROGRAM

This situation is not peculiar to New York State. It is a countrywide and even a worldwide problem. However, in New York there probably is more urgency because of the high degree of urbanization and industrialization, and there is already some activity because the State has recognized the existence and general outline of the problem earlier than most other jurisdictions have. The first official State recognition of solid waste disposal as a major problem in environmental health came in 1962 with the adoption of refuse disposal regulations in the State Sanitary Code. In brief, these regulations require that all refuse disposal sites be operated as sanitary landfills (thus, no more open dumps) and that municipal refuse incinerators be operated in such a manner as to prevent any nuisance or hazard to public health. The Federal Solid Waste Disposal Act in 1965 gave a substantial boost to the State program, largely by facilitating program development and establishment of an effective staff. Thus, early in 1966 the Department of Health was designated as the State agency to see that the purposes of the Federal Act were carried out.

Formal planning for solid waste disposal is already underway in New York State. By 1968, comprehensive studies of solid wastes had been conducted in nine counties and in New York City. By fiscal 1970, similar studies for 12 more counties are expected to be completed, and by 1972, each county of the State is expected to have the benefit of a comprehensive solid waste planning study. Through 1971, the State expenditures for these studies will be about two million dollars.

New York has participated in the U. S. Public Health Service's national survey of incinerators, land disposal sites, and community solid waste disposal practices. In addition, the State has started a county-by-county inventory of industrial and agricultural solid and liquid waste generation. The State has also launched an aggressive public information campaign including such features as: demonstrations of sanitary landfill operations; technical and public relations symposia; and dissemination of applicable technical publications.

Enforcement of the State Sanitary Code and other laws and regulations has resulted in the elimination of almost half the open dumps that were in operation in 1962. Inspections by local health units, conferences with municipal officials and private contractors, and judicious imposition of fines have been key points of the enforcement program.

Another organization used in New York State in the approach to the solid waste problem is the Pure Waters Authority. This unique organization, created by the State in 1967, is a public benefit corporation which, upon invitation by the municipality or municipalities concerned, can plan, finance, construct, operate, and maintain solid waste disposal facilities. The contracts between the municipality and the Authority can provide for either municipal or Authority operation.

APPROACH TO STATE-WIDE SOLID WASTE PLANNING

There are many activities and agencies involved in solid waste planning, and it is highly probable that there will continue to be a need and justification for this multi-faceted attack on the problem. This is just one indication of the complexity of the problem that compels an organized and systematic approach to State-wide planning. Development of this systematic approach requires the following steps:

1. Select the State role (or scope of activities) which will best serve State needs.
2. Establish the overall Objectives commensurate with the selected role.

3. Define the approach (Goals) for the Objectives.

4. Then develop a Plan by which the Objectives and Goals may be attained.

Selection of the State role must be based on the present functions of the State agencies, analysis of the present and projected solid waste situation, and consideration of additional functions. All agencies now involved in solid waste planning should cooperate in the development of a master set of Objectives, and then each agency should develop its own Goals and Plans to delineate its own assigned share of functions in the State role. The emphasis should be on planning rather than plans, because otherwise there is the danger of developing a static, immobile pattern that would lose its relevance with the passage of time.

An effective solid waste management program should have three basic parts:

1. Development of a long-range State-wide plan, with adequate consideration of community, industrial, and agricultural growth, land use, and all applicable aspects of solid waste technology.

2. Development of interim local and regional plans compatible with the State-wide plan.

3. Assistance to municipalities in solving immediate problems in such a manner as to promote compatibility with the long-range plans.

All planning studies undertaken in the State of New York must be concerned with effective collection of basic data, because the handling and disposal programs can be only as valid as the information on which the calculations and analyses are based.

OBJECTIVES AND SCOPE OF THE STUDY

To complement its own professional resources, both in numbers and in variety of disciplines available, the New York State Department of Health retained ROY F. WESTON, Environmental Scientists and Engineers, of West Chester, Pennsylvania to assist in preparation of the State Plan and Program.

The extent of the ROY F. WESTON effort was divided into phases to clarify the requirements and to facilitate scheduling. Phase 1, the subject of this report, was designed to:

1. Analyze the status of solid waste data collection efforts and the accuracy and reliability of the data.

2. Determine the extent of the solid waste problem in the State.
3. Review the needs for solid waste management, and determine how the State Government should fulfill these needs.
4. Conduct a preliminary evaluation of existing and future approaches to solid waste management.
5. Define legislative needs.
6. Develop the directional or planning aspects of the Plan and Program.

Refinements of emphasis which developed as the study progressed showed the need for additional data for all types of solid wastes, the paramount importance of definition of the State's role or scope of functions, the importance of intermunicipal cooperation, the need for preliminary delineation of regional service areas, and participation of the consultant in the public relations aspects of the program.

CONDITIONS AFFECTING THE SOLID WASTE PROBLEM

Considerations of population, industrial and agricultural activity, transportation, geography, political organization and attitudes, sociological implications, and financial resources, all strongly affect the solid waste problem and the development of workable solutions. Hence, the underlying physical, demographic, political, and economic considerations must be explored as a basis for understanding of the solid waste program.

POPULATION GROWTH

The historic and projected future growth patterns in the State of New York constitute a strong determinant for selection of disposal sites and other solid waste handling facilities. Adequate knowledge of the present and projected concentrations of population are an essential basis for determination of the solid waste distribution.

The importance of land use and zoning controls cannot be overstated in relation to disposal site development. Compatibility of the site with overall area development is critical from the standpoint of operations and efficiency as well as from that of aesthetics and public acceptance. While location of solid waste disposal sites and facilities in terms of proximity to existing land uses is important, it is even more important when related to future land use. A landfill operation represents an interim use of a given tract of land; thus, its land redevelopment aspects must be closely coordinated with the projected land use for the surrounding area.

Significant data on present and projected total population and population density, State-wide and for economic development areas and counties, were accumulated and presented in appropriate tables and maps. Of particular interest are the computer-constructed population density Maps which provide a quick, clear picture of the trends of population growth and distribution.

The following tabulation shows the areas most significantly affected by population shifts.

Area	Percent of Total State Population		
	1965	1995	Change
New York City	44.9	34.3	- 10.6
Mid-Hudson	4.2	6.7	+ 2.5
Nassau-Suffolk	12.9	19.3	+ 6.4
Westchester-Rockland	5.8	7.6	+ 1.8

The projected pattern of growth in all the metropolitan regions of the State is little change in the core cities accompanied by substantial population increase in the surrounding suburban and rural areas. The impact, on solid waste management, of this general pattern is that there will be less land available within convenient distances of population centers for solid waste disposal.

INDUSTRIAL AND AGRICULTURAL ACTIVITY

Not only are industry and agriculture two of the principal generators of solid waste, but the types and amounts of waste are significantly influenced by the types and levels of activity. Thus, examination of the industrial and agricultural mix and activity levels in all parts of the State is an important part of the information basis for a State-wide solid waste plan. In particular, locating the centers of activity is important in determining concentrations of waste generation and in laying the foundations for possible regional approaches to solution of the solid waste problem. As with population analysis, the twelve Economic Development Areas were used to facilitate data collection and interpretation. The data collection effort involved determination of the number of employees in various significant industries (by SIC codes) and of the activity levels in the significant crop and livestock operations.

The following summary indicates the areas where the most significant changes are expected:

	Percent of State Total					
	Industrial Employment			Agricultural Acreage		
Economic Area	1965	1995	Change	1965	1995	Change
Binghamton	2.60	8.63	+ 4.03	2.59	1.06	- 1.53
Buffalo	11.59	10.38	1.21	12.55	17.37	+ 4.82
Elmira				9.13	6.32	- 2.81
Mohawk Valley	3.05	7.31	+ 4.26			
New York City	47.41	16.82	- 30.59			
Northern	1.26	5.44	+ 4.18	5.99	4.23	- 1.76
Rochester	8.22	21.45	+ 13.23	41.02	46.58	+ 5.56
Syracuse	4.54	8.72	+ 4.18	12.61	10.36	- 2.25

These intra-State changes of distribution are projected in the context of a 166 percent increase in overall industrial empolyment and a 35 percent decrease in overall agricultural activity.

TRANSPORTATION

In assessing the present situation and future development of transportation, this study covers only those transportation elements (highways, railroads, and canals or other waterways) pertinent to the economic transport of solid waste to ultimate disposal sites. Two general considerations or aspects of transportation are important in the evaluation of its impact on the solid waste situation: the physical extent of the various transportation networks, in terms of miles and quality of roads or trackage, geographical distribution, etc; and the methods and practices of each transportation mode, in terms of types of equipment, technological improvements, accessory facilities, etc. Another important consideration is coordination among the highway, railroad, and waterway systems.

The real question, in the final analysis, is the effectiveness of these major transportation systems in the handling of waste materials. Their usefulness will vary for different solid waste situations. For instance, for small population centers in relatively sparsely settled areas, highways are of paramount importance. For major population concentrations, where area-wide or regional disposal systems may be required, highway effectiveness, although still important, is conditioned by development of "containerized" vehicles, changes in vehicle limitations on highways, and other elements of highway methods and practices. The applicability of railway and waterway systems is a function of the type of waste and the relative locations of waste generation and waste disposal.

PHYSICAL AND NATURAL CONDITIONS

The physical and natural conditions most relevant to development of satisfactory solid waste disposal are geology, topography, hydrology, and meteorology. The types of soil and bedrock, the location of ground-water aquifers, the terrain, and the climate, all affect the location of solid waste disposal facilities, especially of landfill sites and incinerators. Meteorological conditions (wind velocity and direction, temperature, rainfall, etc.) also affect the operation of disposal facilities and transportation systems. The diversity and complexity of pertinent natural conditions are such that detailed investigations by hydrogeologists and other environmental scientists is necessary for satisfactory site selection.

STATE AGENCIES AND LEGISLATION

The most critical elements in the effectiveness of any State-wide solid waste plan may very well be the legislation and the functions and responsibilities of the agencies designated to implement the legislation. There is already significant legislation in the State of New York with current or potential impact on solid waste management and disposal. Much of it is clear and provides explicit direction, but some laws and regulations overlap, which generates some difficulty in interpretation and direct effectuation. In general, the present legislation and related activities provide the basic machinery for action but are lacking in regard to enforcement requirements, particularly in connection with existing facilities and operations.

The three most significant legislative actions (Part 19 of State Sanitary Code, adopted in 1963; the creation of the Bureau of Solid Wastes Engineering and Community Environmental Health in 1966; and the establishment of the New York State Pure Waters Authority in 1967) must be viewed in the light of what they permit or require counties and municipalities to do regarding solid waste collection, storage, treatment, and disposal. The Municipal Home Rule Law, the General City Law, the County Law, the Town Law, the Village Law, the Public Health Law, and the charters of cities and some counties, all contain provisions authorizing units of local government to enact laws, ordinances, or rules and regulations pertaining to solid waste collection and disposal.

Despite the general soundness and coverage of the legislative base, these are some aspects that may present problems in achievement of the objectives of the solid waste program. This limiting factor can generally be summarized as lack of State legislation requiring local governments to provide for solid waste disposal; the existing laws merely empower or allow such provisions, but do not make them mandatory.

Currently there are three State agencies that have a substantial direct involvement in the solid waste program:

1. Environmental Health Services, in the Department of Health.

2. Community Health Services, also in the Department of Health.

3. Pure Waters Authority.

The combined activities of these three agencies represent the major part of the State involvement. There are other agencies that have impact on or interest in solid waste disposal as it affects their primary function; these include: The Bureau of the Budget, The Department of Audit and Control (Division of Municipal Affairs), The Office for Local Government, The Office of Planning Coordination, The Department of Transportation, The Department of Conservation, The Bureau of Surplus Real Property of the Office of General Services, The Department of Commerce, and The Department of Agriculture and Markets.

There is need for an improved structure and better definition of relationships between and within the principal agencies, and between them and the agencies which now have only peripheral involvement. The State Legislature has investigated such a reorganization, but the final report is not yet available. Reorganization, along with clarification of enforcement responsibilities of the State and of local governments, would greatly facilitate accomplishment of the major objectives of the State-wide solid waste disposal program.

POLITICAL, SOCIOLOGICAL, AND FINANCIAL FACTORS

Closely related to the actual legislation and regulations is the political and sociological framework within which government actions are carried out in the State of New York. The political climate and cultural aspirations influence the kind of legislation that can be enacted and the vigor of its enforcement.

Politically, New York is a "home-rule" State, in that virtually all prerogative for action and provision of services lies at the local level. Proposals to move away from this base generally encounter strong opposition, frequently with emotional overtones. There is ample legal basis for intermunicipal cooperation to provide any service or function that municipalities are authorized to perform on an individual basis. But the political climate is such that intermunicipal cooperation is still very much the exception rather than the rule.

In regard to solid waste disposal, the situation is further complicated by sociological considerations which generate resistance to disposal of refuse across municipal boundaries. "No one wants his own or anyone else's garbage in his backyard", is an accurate reflection of the prevailing sentiment. As a consequence, less than 35 percent of the State's 1500 municipalities use solid waste disposal facilities operated by another unit of local government.

The financing of solid waste disposal is a serious problem now and will become more serious. Cities, towns, and villages are becoming financially strapped. The economies of the larger-scale operations of regional facilities should be an important consideration, but proposals of this sort have frequently been a casualty of the home-rule spirit and its concomitant resistance to intermunicipal cooperation. State financial aid could help break down these barriers, but the State's financial picture is not much brighter than that of the local governments. Nevertheless, the State will have to become involved in the solid waste program, and new State vehicles for financing will have to be found to insure development of an adequate program.

One potential source of outside aid is the Federal Government. There is federal legislation pending which would provide construction grants for new solid waste disposal facilities, but these legislative proposals do not yet include the provision for grants to encourage and insure proper management and operation once a facility has been constructed. This latter type of grant would be an essential factor in promoting and maintaining the intermunicipal cooperation demanded by the nature of the overall solid waste problem.

COLLECTION AND ANALYSIS OF DATA

The primary objective of the current data inventory, analysis, and development is to provide the desired information accurately enough to satisfy the planning requirements. However, solution-oriented information, such as precise locations of sites, precise sizing of facilities, etc., is unnecessarily detailed for this stage of the program.

Basic data sources are scarce. The U. S. Public Health Service's National Survey of Community Solid Waste Practices, the New York segment of which was completed in 1968, is currently the most comprehensive source of data applicable to development of solid waste management plans for the State of New York. Other reports of solid waste studies conducted for governments both within and outside of New York State provide data on solid waste generation, collection and disposal costs, and facility operational characteristics.

Waste generation rates are dependent on the makeup of the community or area under study. Since solid waste generation depends on many factors, the use of a single waste generation rate to define all wastes for every community and region of New York State would be unsatisfactory. In this study, wastes were grouped into municipal, industrial, and agricultural categories for separate determination of waste generation rates. Waste generation rates are used in preference to waste collection rates; although the latter may be easier to obtain, they do not furnish as firm a basis for calculation of future solid waste quantities because some current on-site disposal practices (backyard burning of domestic refuse, in-field burning of agricultural refuse, etc.) probably will change.

EXISTING SITES AND FACILITIES

Without knowledge of capacities, remaining life, cost, environmental effects, and special capabilities of existing solid waste disposal sites and facilities, it would be impossible to determine what aspects of solid waste disposal are deficient at present, what improvements are needed, and what the magnitude of the facilities and sites program is.

Information on solid waste collection and disposal costs, along with related data on tax base, bonded indebtedness, and similar factors, is needed to ascertain both the demand of solid waste disposal activities on public funds and the competition from other municipal services. Then appropriate allocations of State funds to support a solid waste program can be made without unjustifiably reducing other State programs.

The New York State segment of the USPHS National Survey of Community Solid Waste Practices included determination of the operating characteristics and capabilities of solid waste land disposal sites, incinerators, and other facilities. Tabulation of operational characteristics of land disposal sites shows various deficiencies for the existing sites:

> 66 percent pollute the air (particulates and malodors as a result of open burning).
>
> 18 percent are vulnerable to washing of refuse into surface waters, because of improper drainage.
>
> 18 percent have leaching problems.
>
> 15 percent place refuse below the ground-water table.
>
> 44 percent experience uncontrolled rodent problems.
>
> 31 percent experience uncontrolled insect, odor, or dust problems.

Of the 921 sites investigated during the survey, 168 were reported as sanitary landfills, but only 51 of these meet the principal criteria for sanitary landfills. Re-inspection of 26 of the "sanitary" landfills in the summer of 1969 revealed that only 13 were meeting "sanitary" requirements. It is apparent that landfill conditons can vary and that continued vigilance is necessary to maintain satisfactory operation.

Unused capacity of existing sites is another landfill factor that significantly affects the development of a solid waste disposal plan. Review of compilation of existing solid waste land disposal area indicates that more than 40 percent of the sites will be exhausted in five years or less.

Solid waste facilities include incinerators, grinders, crushers, transfer stations, compost plants, conical burners, and hog feeding lots. Of these, incinerators are the most prominent. Incinerators with a rated capacity of about 22,000 tons/day handle solid waste for almost 4,000,000 people. Many of these are approaching or are well past the widely-applied criterion of 20 years of useful life, and new air pollution control regulations threaten the continued use of many others. The tabulation of environmental aspects of the existing incinerators, although insufficient for definitive evaluation of future feasibility, does point out the general inadequacy of present incinerators for future solid waste disposal.

The preliminary State-wide solid waste survey provides some information on annual operating and facility replacement costs from which unit cost (per ton) values can be calculated. The most obvious conclusion is that costs vary widely throughout the State. For example, incinerator operating costs ranging from $0.21 to $28.00 per ton have been reported. Replacement cost estimates generally fall in to $6,000-$12,000 per design ton range, which seems quite low compared to recently published estimates.

PROJECTIONS OF SOLID WASTE GENERATION

The heart of the solid waste data inventory and analysis is the determination of future solid waste tonnage and its distribution. In this study, solid wastes were divided into three general categories - municipal, industrial, and agricultural - to facilitate calculation. The ground work was provided by the population, industrial employment, and agricultural acreage projections presented earlier. What remained to be done was to develop unit waste generation rates, including projections for future years, and then to calculate tonnages for the selected target years.

Municipal wastes are those attributable to non-manufacturing and non-agricultural activities, and include: residential wastes, commercial wastes, institutional wastes, demolition and construction debris, and street sweepings. The obvious basis for unit rates is population, and considerable data on waste collection rates are available. The most reliable relationship for projecting future waste loads appears to population density vs. per capita collection rates.

Practically all studies of the solid waste problem show that per capita solid waste generation will increase in the future; thus current per capita figures cannot be used for calculating future waste quantities unless they are adjusted for growth.

The adjusted collection rate multiplied by the population for the desired target year gives the total waste collected for each community for that year, in pounds per day. Conversion to tons per year and development of county and State totals are straightforward arithmetical operations.

Determination of a unit generation rate for industrial solid waste was based on the number of employees. While specific circumstances at a specific manufacturing establishment could distort an average unit waste generation rate, the rate should be reasonably uniform throughout an industry group.

Although no comprehensive survey of industrial solid wastes has been conducted in New York, results of such surveys in California (and, to a limited extent, in Pennsylvania) are applicable to the New York State situation. To determine unit solid waste generation rates for the various industries, the solid waste tonnages reported in the 1967 California report for the various Standard Industrial Classifications (SIC) were divided by the California employment in those SIC coded industries as reported in the 1967 U. S. Census Bureau publication, County Business Patterns.

Industrial solid waste quantities for the target years were calculated from the unit waste generation rates based on the California data and from projected employment data, based on County Business Patterns for 1962, 1965, and 1967 and supplemented by New York Department of Commerce forecasts of SIC coded industries in the various counties. Current unit waste generation rates could be used because there was no discernible time-related trend in the available data.

Agricultural wastes include: manure from penned animals; harvesting residue and crop spoilage from field crops; trimmings, residue, and spoilage from fruit and nut growing; and trees lost through disease. As with industrial solid waste, there was little information readily available on agricultural waste generation in New York State. However, Cornell University and California studies on agricultural solid waste proved to be sources of usable information. From them, unit waste generation rates in terms of Tons per acre (or per head) per year were derived. Barring an abnormality such as the onset of a serious and widespread tree disease, the unit quantities of agricultural waste are not expected to change significantly in the future.

Projections of acreages and number of animals for the target years were developed in a manner similar to that used for industrial solid wastes. In this case, the basic agricultural activity data were obtained from the Census of Agriculture (U. S. Bureau of the Census) for 1954, 1959, and 1964 for each county. The waste generation rate for each agricultural activity class was then multiplied by present and projected number of animals or of acres to get the county and State totals for each target year.

The municipal waste projections, industrial waste projections, and agricultural waste projections were added to obtain "Total Wastes from All

Sources by County and State" for 1965, 1970, 1975, 1985, and 1995. The following tabulation, gives an overview of the main sources of solid waste State-wide:

	Solid Waste in Thousands of Tons				
Source	1965	1970	1975	1985	1995
Municipal	13,640	14,470	17,380	25,680	38,280
Industrial	5,090	5,080	5,450	9,040	19,070
Agricultural	22,100	21,340	20,800	20,400	21,180
All Sources	40,830	40,890	43,630	55,120	78,530

This indicates that solid waste generation will practically double between 1965 and 1995, with about 30 percent of the increase in the 1975-95 decade and 60 percent in the 1985-95 decade. However, these data are based primarily on waste generation and thus may not always be an accurate reflection of the load or demand on public waste disposal facilities. Strangely enough, the projected values for 1975 and beyond may be more meaningful from a disposal basis than the 1965 and 1970 values. Agriculture is the source of more than half of the 1965 total, but only those agricultural activities involving penned stock currently have an impact on disposal, because other agricultural solid wastes normally are disposed of on-site. The present agricultural load on public solid waste facilities is also affected by the sale or use of manure for fertilizer. However, air pollution and water pollution regulations may prohibit present on-site disposal practices, and manure may be replaced by synthetic fertilizers. On the basis of such considerations, the longer range projections become more realistic.

SPECIAL WASTES

Up to this point, special wastes have not been included in the discussions or in the projection of future waste quantities, largely because of the almost total lack of usable information. A special waste is defined here as any refuse which presents a specific problem to one or more of the elements of any public waste collection and disposal system.

The major categories of special wastes are radioactive wastes, mining wastes, dredgings, industrial special wastes, and wastewater and water treatment sludges. The radioactive wastes and the sludges do not constitute a significant portion of the overall quantity of waste requiring disposal but do involve unique quality problems and consideration of special types of facilities. Mining wastes and dredgings, on the other hand, involve enormous quantities of materials. Dredgings probably represent the more serious problem, because in most cases, mining operations, which are extractive processes, permit extensive use of acceptable or even desirable on-site disposal. Industrial special wastes constitute a kind of catch-all category. Knowledge of the processes and procedures makes possible a reasonable qualitative definition of the classes of waste that are generated, but specific and detailed data of an industry's actual capacity and waste production potential are required for estimation of the quantities involved.

SUPPLEMENTAL DATA REQUIREMENTS

This problem of special industrial wastes, as well as the previously-indicated problems related to continuation of present disposal practices for the more conventional industrial and agricultural solid wastes, underscore the need for additional efforts in the field of data acquisition and record keeping. The data developed to date are sufficient for the initial phase of the planning effort -- the development of the State-level approach. Whether or not these data are sufficient for subsequent studies depends, of course, on the purposes of those studies. It would be presumptive to attempt a full definition of such studies at this time, but it can be safely assumed that some will be sufficiently sophisticated to require improvement in the existing data and that others will be so different in concept as to require new types of data. Systems analysis including the development and solution of mathematical models, appears to be a highly effective approach to decisions involving location and size of sites and facilities, the quality of their operation, the transfer of wastes from their sources to the facilities, and the scheduling of the development of the various facilities. It is apparent that the following will be required:

1. Sources and quantities of solids waste requiring disposal.
2. Additional data collection and analysis, for refinement of municipal, industrial, and agricultural solid waste generation rates.
3. Capabilities of existing sites and facilities for disposal of the expected quantities of solid wastes.
4. Environmental, technological, and financial impact of special wastes whose complex nature present distinct handling and disposal problems.
5. Estimated costs of future solid waste disposal.
6. Future conditions such as land availability and air pollution control regulations, which will affect solid waste disposal.

Many of the data accumulation efforts require recording over appreciable periods of time, in addition to specific surveys. Perhaps the key element in supplemental data acquisition is the implementation of a waste classification system.

Such a classification system has been developed through the cooperative effort of ROY F. WESTON and DEPARTMENT OF HEALTH personnel. It has not yet been tested, however, and some modification may be required when it is put into practice. Essentially it consists of: 1) a division into the three major classes of Solid, Liquid, and Gaseous Wastes; 2) a first subdivision into functional classes, i.e. physical descriptions which denote particular problems particularly in collection and handling; and 3) a second subdivision into analytical classes, generally chemical descriptions of the nature of the material, which also denote particular problems of collection, handling or disposal and which provide immediate problem definition.

Information through the second level of classification generally will be sufficient for a State-level study, but information through the third level will be needed for engineering design of facilities. The proposed Plan and Program includes further development and extensive use of the waste classification system.

ELEMENTS OF A STATE-WIDE SOLUTION

Two major elements underlie the development of a State-wide solution to the solid waste disposal problem: ultimate use of the filled land, and the advantages of a regional approach. Not only is understanding these two elements essential for determination of sites for land disposal of solid wastes, but they are also major considerations in securing the public acceptance that is necessary for the development and implementation of an effective State-wide program.

Site reuse, or redevelopment, is described and discussed first as a frame of reference for selection of the most beneficial end use from among the reasonable alternatives, and then in relation to implementation requirements and related problems. To illustrate site reuse and the attendant problems, a case history of a hypothetical disposal site is presented as a complete program of site development from the original use before the landfill operation to implementation of the ultimate use.

This case history concerns the use of a 600-acre plot as a sanitary landfill, with eventual conversion of the original farm land into a Planned Unit Development embodying a mixture of several residential structure types, a small commercial facility, an area for light industry, and various kinds of recreational areas. The placement of the various uses recognizes the inherent constraints of building on fill areas, on areas of cut and fill, and on undisturbed earth; the location of the industrial and commercial facilities also takes into account the adjacent land uses and the requirements for access. Commercial activities are geared to the projected needs of the residents of the site and of the surrounding area. Recreation to meet the needs of the area residents (riding trails, picnic areas, active play fields, a golf course, swimming pool), is proposed as the most practical used for the actual filled areas. A series of maps gives an excellent overview of the entire illustrative project.

This hypothetical site project implies, particularly in the discussion of access to the disposal site, a regional approach to solid waste disposal, i.e. the site would serve not only (not even principally) the residents of the immediate area, but would take care of the waste from a considerable surrounding area.

SERVICE AREAS

The advantages of regionalization (lower unit costs, better operation, more effective site selection, more thorough pre-planning, and a sounder basis for financing) are widely recognized, but its application has been hampered by the inability to obtain the necessary cooperation of adjoining municipalities. However, the exigencies of the situation are such that the State Government will have to undertake the responsibility for promoting regionalization.

What exactly should the State promote? The factors affecting the creation of a regional system must be analyzed to define those areas which logically would be engaged in cooperative efforts. To avoid confusion with existing usages of the term "region" in New York State, the term "Service Area" has been chosen to represent a portion of the State for which cooperative solid waste effort is appropriate.

The major objective in delineating a Service Area is to realize the least cost consistent with the most effective and manageable disposal means. The delineation of Service Areas must be directed primarily at meeting future demands, but as an interim measure it may be economically feasible or politically expedient to develop cooperative efforts only on a sub-area basis.

The task of defining a Service Area is clearly in the realm of systems analysis, based on a mathematical model for selection of the optimum alternative. Boundary definition is best accomplished through solution of such a mathematical model. Nevertheless, general criteria provide sufficient basis for an illustrative delineation of Service Areas in New York State. The data defining the density of waste generation were used to delineate Service Areas and sub-Service Areas.

Although the intent is to divide the entire State into Service Areas, it is not necessary to set up a Service Areas for any portion of the State where the regional approach would provide no significant benefit. In fact, the current study indicated that two large sections (in the Northern and Southwestern parts of the State) would not benefit by regionalization.

Division of the State into Service Areas permits rational estimation of future land requirements and facilities costs. Tabulation of the acreage requirements for the Service Areas and for the two general regions, indicates that more than 80,000 acres would be needed in the 1970-1995 period if all projected municipal and industrial wastes were to be disposed of solely by sanitary landfill. This requirement would be reduced to 20,000 acres if all such waste were incinerated before being landfilled. This is a significant amount, as is clearly demonstrated by the comparison with the 1966-reported figure of 16,385 acres devoted to land disposal of solid wastes. The significance increases upon consideration that less than half of this acreage had a life expectancy of more than 10 years.

The cost estimates, State-wide, are as follows:

	Operating Costs for Disposal of Solid Wastes in Millions of Dollars				
	1970-75	1975-85	1985-95	1970-85	1970-95
Sanitary Landfill	133	362	544	495	1,039
Incineration + Landfill	536	1,462	2,206	1,998	4,204

This summary shows that the cost over the next 25 years can range between One Billion dollars (for landfill alone) and Four Billion dollars (when incineration is involved for all municipal and industrial solid wastes). Actual costs probably will fall between these extremes, because various combinations of landfill and incineration are likely to be used. In any event, it is obvious that the cost will be high.

The delineation of Service Areas also helps to dramatize the problem posed by the decreasing availability of land suitable for sanitary landfill. To illustrate this problem, a complete listing of all State-owned properties was prepared and analyzed for suitable size, topography, present land use, and proximity to transportation.

The resultant list of selected State-owned lands indicates that 27 percent of such acreage would be required for disposal of solid wastes, which may actually represent all the potentially available State-owned land, because many of these lands are already being used for activities high in public interest. It must be emphasized that this exercise with State-owned lands is for illustrative purposes only and must not be construed as any gurarantee of their availability.

STATE ROLE

Just as the data previously discussed must be directed to specific local conditions, the Role of the various governmental agencies cannot be predetermined precisely. However, general guidelines can be developed at this point. Two levels of governmental involvement are involved in overall solid waste management:

1. State, which refers to a level of government and not to specific organiztion units.
2. Local, which covers all governmental entities below the State level.

In the development of the State role it is clear that many alternatives are available. These alternatives can be categorized as: 1) a Control Agency; 2) a Control Agency and Technical Center, and 3) a Control Agency, Technical Center, and Implementation Agency. Within these broad categories are gradations of involvement.

The conclusion of ROY F. WESTON is that the State level of involvement should be that of Control Agency and Technical Center plus some aspects of an Implementation Agency. This would include: review of plans (of local governments) for scope and for technical and geographical sufficiency; provision of a data bank, computer system, technical advice, training programs, and field consultation; sponsorship of research and development activities; administration of construction and operation grant funds; planning for and promotion of advance acquisition of landfill sites; and participation in construction and operation of special demonstration projects. While the State should not be in the business of providing actual disposal of solid wastes, it has a responsibility to develop and demonstrate solid waste planning, engineering, and management techniques, and to set up the instruments for effective implementation.

PLAN AND PROGRAM

The Plan and Program developed from the current study are presented in the form of Objectives, Goals, and Tasks. The basic foundation is the State Role and scope of functions just discussed. The form of presentation is consistent with the concept of dynamic planning, which provides positive direction for meaningful action. The Objectives provide the stable, long-term frame of reference for action; they are specific enough to provide positive direction and at the same time are broad enough that major changes in basic policy would be required before the Objectives would have to be restated. The Goals are the major guideposts along the routes pointed out by the Objectives; consequently, they are more detailed, more positive, and frequently have target dates for completion. The Tasks, which are component parts of the Goals, must contain the details requiring attention during the specific planning period.

An essential element of the dynamic planning concept is the periodic (usually annual) review of the entire set of Objectives, Goals, and Tasks.

Objectives are seldom changed, because they reflect basic policy which, when properly established originally, should not change very often. Goals and Tasks are reviewed for progress or completion, and to determine the need for changes in content or priority. Necessary changes are made to the Goals, and a complete new set of Tasks is developed for the next planning period.

In the solid waste Plan and Program for New York State the Objectives are as follows:

I. *Achieve and maintain effective disposal of all solid wastes in New York State.*

This includes all the actions necessary for development of facility design and operating criteria and for proper enforcement of all pertinent laws, rules, and regulations.

II. *Achieve efficient and economical disposal of all solid wastes in New York.*

The main focus here is the responsibility of the State to help the local and regional systems to achieve economical solutions. State-level solid waste planning is also a part of this effort to achieve efficiency.

III. *Develop and maintain competent solid waste management practices.*

The emphasis here is on measures to insure competent operation, chiefly through operator training programs and development of management guidelines for local governments.

IV. *Provide proper utilization and conservation of resources.*

This objective forces attention on the overall environmental effects of solid waste handling and disposal, i.e. the land redevelopment aspects, reductions in the amounts of waste generated, reclamation of refuse, etc.

Objectives, Goals, and Tasks have been developed, with Task schedule dates for 1970 and 1971. These cover the actions discussed in this report, as well as programs currently underway in the Bureau of Solid Wastes Engineering and Community Environmental Health. Specific actions are defined, but there has been no allocation of functions to specific State agencies. Such an allocation requires supplementary planning effort on the part of the State of New York, and is included as one of the Goals with a 1970 target date.

The Objectives, Goals, and Tasks provide a sound basis on which the State can build an effective solid waste management program.

CHAPTER ONE

THE CURRENT SOLID WASTE PROGRAM IN NEW YORK STATE

INTRODUCTION

Some years ago, getting rid of solid waste was relatively simple - find a place and dump it. If land was scarce - burn the dumped material. Although these practices resulted in health hazards, air pollution, water pollution, and unimaginable eyesores, the vastness of the environment was able to absorb these conditions without extensive deterioration. This situation has changed.

Our affluent society is generating wastes at an increasing rate and in greater complexity each year. At the same time, the amount of land available for disposal is decreasing as the trend toward suburban sprawl creates a megalopolis. More people are demanding a higher-quality environment, not only in the interest of a healthier life, but also for the fuller enjoyment of outdoor recreation and scenic beauty. One effect of these desires and pressures has been to make waste disposal the third highest category of expense for many communities (following schools and roads). Resistance to inter-municipal transfer of solid waste has been a complicating factor; all too frequently, the most economical solution in a given situation has been rejected because nobody wants someone else's "garbage" disposed of in his backyard.

This problem has been building for years, and in the early 1960's New York State realized that the development of satisfactory corrective measures was falling seriously behind the rapid growth of the problem. It was estimated that there were over 1,600 open dumps in New York State in 1962, the year before the State officially recognized refuse disposal as a major environmental health problem. The New York State Solid Waste Disposal Program had its start on 28 September 1962 with the adoption, by the Public Health Council, of refuse disposal regulations in the State Sanitary Code. These regulations, in brief, require that refuse disposal sites be operated as sanitary landfills and that municipal incinerators be operated and maintained so as not to create a nuisance or hazard to public health. The Federal Solid Waste Disposal Act (1965) stimulated the state program by making possible the acceleration of staffing and program development. On 11 January 1966, Governor Rockefeller designated the New York State Department of Health as the single State Agency for carrying out the purposes of the Federal Solid Waste Disposal Act.

Solid waste activities for the most part are the concern of the Department of Health's Division of General Engineering and Radiological Health, with overall administrative direction delegated to the Assistant Commissioner. The division has five bureaus, of which the Bureau of Solid Waste Engineering and Community Environmental Health is most deeply involved in the State solid waste program. The Bureau has three sections: Solid Waste Engineering, Solid Waste Planning Grant, and Community Environmental Health. The Bureau currently has a director, an urban planner, six sanitary engineers, and a soils engineer and has openings for an urban planner, two sanitary engineers, and a public information specialist.

STATE OBJECTIVES

The objectives of the current New York State Solid Waste Disposal Program are: elimination of open dumps by disposal of all solid wastes in an economical manner in accordance with a comprehensive area-wide plan which protects the air, water and land resources; reclamation of submarginal or waste land for productive use; prevention of public health hazards and nuisances.

STRATEGY

The strategy to achieve these objectives in New York State includes the following activities:

1. Direct, administer, supervise, coordinate, control, and evaluate the State Program on a continuing basis.

2. Provide for or conduct state, regional, and local planning for solid waste management.

3. Set standards, provide technical assistance, prepare publications and news releases, and give talks to assist in training, development of public understanding, development of professional interest at the university level, and promotion of the concern of knowledgeable consultants in the field.

4. Enforce the State Sanitary Code and other State laws and regulations, in general conformance with the State Plan.

5. Administer any State or Federal grant programs for planning, construction, and operation and maintenance.

6. Integrate the State Solid Waste Program with the Water Pollution and Air Pollution Control Programs and with any other related state, regional, and local planning.

7. Promote advanced acquisition of large tracts of land by county, regional, and state agencies for multi-purpose uses in which sanitary landfill could be used to expedite completion of a specifically desired community project.

8. Conduct, participate in, and stimulate research, demonstration projects and special studies, including waste reduction at the source, waste reuse, and central processing plants for special wastes.

9. Develop technical competence in the solid waste management field.

PRESENT PLANNING ACTIVITIES

One of the most important elements of the New York State Program is the development of comprehensive regional and county solid waste plans covering all populated areas of the State. The planning studies are made possible by 1966 state legislation authorizing 100 percent funding of comprehensive solid waste studies conducted by qualified consulting engineers. These grants stimulate and encourage county and regional planning for the collection, treatment, and disposal of all solid wastes. During 1967 and 1968, nine counties and New York City were studied, the State anticipates that twelve additional counties will be studied during the 1969-70 fiscal year, and plans to have every county covered by 1972. The solid waste planning program was allotted $900,000 for the 1969-70 fiscal year, and the 1970-71 request for funds amounted to $1,200,000. These amounts are exclusive of Federal support.

NATIONAL SURVEY

An inventory of existing solid waste management practices in New York State was completed in December 1968 for the U. S. Public Service Bureau of Solid Waste Management. The inventory included a survey of all incinerators and land disposal sites, and community solid waste practices in New York State. The information obtained was recorded in the State Health

Department's Office of Electronic Data Processing for use in state planning and then forwarded to the U. S. Public Health Service for its national inventory. In addition, New York State initiated an inventory of industrial and agricultural solid and liquid waste generation in the State. This is underway, but the results are not available for this report.

PUBLIC INFORMATION

In its efforts to convert open dumps to sanitary landfills, the State is endeavoring, through an agressive multi-pronged public information program, to provide an understanding of what constitutes a true sanitary landfill. Some of the key points of this program include: demonstration sessions for public officials showing sanitary landfill operations and rat eradication by converting an open dump to a sanitary landfill; symposia on public relations aspects of sanitary landfill disposal for public officials and community leaders; technical symposia on special solid waste handling and disposal for consulting engineers and municipal officials, and dissemination of such publications as "Municipal Refuse Collection and Disposal" and "Sanitary Landfill Planning, Design, Operation and Maintenance". An expanded Public Relations program is planned.

ENFORCEMENT

The State Program is structured to accomplish much of its overall objective through education, consultation, and persuasion, and at the same time retain the cooperation and good will of the local official and operator. However, it also provides for initiating legal action where violations continue unabated. The objective of the enforcement actions is to obtain compliance with the State Sanitary Code and other pertinent laws and regulations. In some cases fines have been levied and collected; this has been successful in stimulating corrective action at other refuse disposal operations.

As previously mentioned, in 1962 there were more than 1,600 open dumps in New York State. Almost 700 open dumps have been eliminated since then, in part because of an aggressive enforcement program. In 1968 alone, local health units made approximately 5,500 inspections of refuse disposal areas and held some 2,300 conferences with municipal officials and private contractors to make recommendations and discuss improvements of operation and maintenance of disposal sites.

PURE WATERS AUTHORITY

A unique approach to accelerate solution of the solid waste problem was the creation of the New York State Pure Waters Authority in 1967. This Authority is a public benefit corporation that can plan, finance (through the sale of bonds), construct, maintain, and operate sewage treatment works and solid waste disposal facilities. Municipalities may contract with the Authority for the design and construction of needed facilities. These contracts may provide either for municipal operation of the completed facility or for operation and maintenance by the Authority on a continuing basis. In addition, the Authority may arrange for the financing of proposed facilities, with design, construction, and operation by the municipality. The Pure Waters Authority therefore provides another mechanism for the solution of the solid waste problem on a regional or area-wide basis in New York State.

CHAPTER TWO

APPROACH TO STATE-WIDE SOLID WASTE PLANNING

To coordinate the many efforts and activities which are involved in Statewide solid waste planning, an organized approach is required. This approach must include the following steps:

1. Select the role or scope of functions which will best serve State needs.
2. Establish the overall Objectives of activities commensurate with the selected functions.
3. Define the approaches (Goals) for obtaining the Objectives.
4. Develop a Plan by which the Objectives and Goals may be implemented.

SELECTION OF STATE ROLE

The Role or scope of functions of the State and its various agencies provides the underlying basis for the planning effort. Selection of the State Role must be based on the functions presently being carried out by each agency, analysis of the existing and projected solid waste situation in the State, and consideration of additional functions requiring attention or effort.

The many elements which affect the selection of State Role are discussed in Parts II and III of this report, and Chapter 20 is devoted to a discussion and description of the recommended Role.

ORGANIZING FOR MANAGEMENT

All decision-making relative to solid waste management should follow an accepted set of Objectives, Goals, and Plans established by the State. Objectives, Goals, and Plans each may be defined as follows:

Objective	- A subjective desirable condition that is reflective of the needs of the State and is generally arrived at by consensus.
Goal	- A measurable end-point within the framework of an Objective, towards which effort is expended, and which is consistent with the selected Role.
Plan	- An action program by which Objectives and Goals may be achieved.

By organizing in terms of appropriate Objectives, Goals, and Plans, the State of New York will be able to provide a realistic solid waste management program for New York State. For example, the primary objective may be to ensure appropriate solid waste disposal within the State at least cost to its citizens. With this in mind, it would be necessary to decide which goals will be required to achieve this objective. A first goal in attaining this objective has been completed by the adoption of regulations in the State Sanitary Code. A second goal may be to meet the regulations in reality by developing a solid waste management plan for the State. Within the framework of each objective, there should be a consistent policy or set of policies by which immediate and long-range decisions can be made. The goals should reflect these policies.

To attain each goal, a plan or set of plans should be formulated. Generally, the plan should be composed of a list of specific tasks which, when accomplished, will effectively move toward achieving the goals. Commonly, each task specified in the plan should be set for one year, so that each year the program status can be reviewed and the next year programmed accordingly.

Many areas of action must be covered by the Objectives, Goals, and Plans. Certain of the tasks will be highly definitive, in that the action required is obvious, once the objectives and goals are set. Other tasks may be less obvious in their relationship to the objectives and goals, and may be designed to obtain information necessary to refine or even define the next step.

A master set of Objectives should be developed in a cooperative effort of all the agencies involved in solid waste planning. Each agency should then develop its own Goals and Plans to conform to the Objectives, and should delineate its own assigned share of functions in the State Role. This report will provide a complete set of preliminary Objectives, Goals, and Plans to serve as a guide for the next year of the planning program, or as guidelines for the construction of a final set in accordance with the procedures outlined above.

This process is basic to any planning analysis and is outlined in the following six-point sequence:

1. Develop a first estimate of existing conditions and significant trends in the area of concern.
2. Determine the principal and most pressing problems and needs, briefly evaluate them, and develop an interim program.
3. Formulate a detailed program indicating priorities for undertaking component studies and comprehensive plans.
4. Carry out detailed plan studies according to program and priority.
5. Integrate various plan studies into comprehensive plans.
6. Revise plans as conditions alter their applicability.

This approach is geared directly into the cycle-like sequence that is essential to dynamic planning. With such a process, the policies and plans are progressively refined to develop an acceptable plan, but as conditions alter the applicability of the findings, the policies and plans are modified to conform. The emphasis on planning rather than plans is underscored as an essential thought process as differentiated from a "blue print" concept, which tends to fix end points in a static, immobile pattern that loses its relevancy over time.

THE SOLID WASTE MANAGEMENT PROGRAM

The Objectives, Goals, and Plans constitute the overall program for the state and its constituent agencies. It is a composite of policies and projects which are defined in a hierarchy of scope and time. As the formulation of the elements or policies proceed from the general to the particular, each level of policy making supplies the foundation for subsequent, more detailed policy determinations. The solid waste management program is the engineering counterpart to this conceptual approach to policy making.

The solid waste management program contains three basic parts or concepts of service and solution.

1. Development of a long-range comprehensive plan for solid waste management in the State, considering community and industrial growth, land use, and all appropriate aspects of solid waste technology.

2. Development, within the long-range plan, of interim local and regional plans which will consider community and industrial solid waste problems and disposal needs, and which will maintain the necessary flexibility and compatibility with the long-range plan.

3. Assistance to municipalities in solving immediate problems. This may range from initial investigations of problem situations to advising on construction of facilities in situations where the problem has already been defined and the proposed solution has been approved by the appropriate regulatory body. The State should recognize such problems and assist in a manner which will insure that such measures are compatible with the long-range plans.

DEVELOPMENT OF THE PLAN OF IMPLEMENTATION

An effective Plan of Implementation requires effective collection of basic data and information. The answers produced are only as valid as the basic information upon which the calculations and analyses are based.

The planning studies and efforts initiated in the State of New York must be (and to a great extent are) directed toward an accumulation of these required basic data. These efforts must include:

1. Collect, analyze, and summarize all available data to determine waste sources (locations), quantities, characteristics, and modes of occurrence. Using appropriate methodology dictated by the sufficiency and validity of data, make projections of solid waste data, population, employment, land use, and other pertinent information.

2. Review solid waste practices, programs, existing and proposed legislation, and intermunicipal cooperation to assess the status of solid waste management in New York State.

3. Identify solid waste management problems and needs and define additional data requirements.

4. Develop alternative solutions by utilizing a mathematical model capable of designing both individual disposal systems and a master system of systems.

a. Develop estimates of capital, operating, and administrative costs for the initial and future facilities required and a formula for equitable sharing of costs by the users in the systems.

b. Develop the need for immediate or short-range facilities and evaluate possibilities of these facilities serving as interim solutions compatible with long-range plans.

5. Define the roles of regional and local government agencies in solid waste management.

6. Develop the priorities for implementation.

7. Devise an implementation schedule which is consistent with the priorities and with the overall program, paying particular attention to the following aspects:

   a. Technical assistance

   b. Economic impact

   c. Financial assistance

   d. Legislative requirements

8. Develop a well-planned public information program, which will not only advise industries and municipalities within the State but will also encourage their participation wherever possible in the development of a comprehensive plan and of regional facilities. Dissemination of information should logically occur through the normal media of newspapers, radio, and television. Popularized versions of completed reports should be issued to keep the interested parties well advised.

9. Simultaneously with the development of a State-wide plan, develop research and demonstration projects aimed at improving the design and operation of applicable facilities.

Development of the Implementation Plan should proceed simultaneously with or immediately after the creation and refinement of the mathematical models. The public information program required to advise the public and industry as well as State and Federal governmental officials of the comprehensive plan should begin before the plan is finalized. In fact, a portion of the comprehensive planning should include public meetings, held primarily to gather information and to publicize the intentions of the State Department of Health.

Some of the elements listed above are a part of this study and have been completed or effectively begun. Others remain for future study phases and are outlined in Chapter Seventeen.

CHAPTER THREE

OBJECTIVES AND SCOPE OF STUDY

Development of all parts of the State Plan and Program requires a comprehensive investigation of many elements. This necessarily involves a multidisciplinary approach to ensure effective evaluation of each element and to blend the elements into an appropriate solution. Completion of such a study also requires a considerable amount of time and effort. To complement its own professional resources, both in numbers and in variety of disciplines available, the New York State Department of Health retained ROY F. WESTON, Environmental Scientists and Engineers of West Chester, Pennsylvania, to assist in the preparation of the State Plan and Program.

A proposal was prepared which covered all of the efforts necessary to complete the elements in the State Plan and Program. It was immediately apparent that this project could not be completed within a year. Furthermore, funding limitations prevented consideration of the total effort in one contract. Therefore, the project was divided into phases. This report presents the results of Phase I.

This first phase was designed to: analyze the status of solid waste data collection efforts and the accuracy and reliability of data; determine the extent of the solid waste problem in the State; review the needs for solid waste management, and determine how the State Government should fulfill those needs; conduct a preliminary evaluation of existing and future approaches to solid waste management practices, define legislative needs; and develop the directional or planning aspects of the plan and Program. Efforts toward implementation of the Plan and Program were reserved for subsequent phases.

This phase of study began in March 1969 and was to be completed in eight months. The efforts included are described in more detail in the following paragraphs.

DATA COLLECTION

The logical first steps in any study are to determine what data are available and what additional data processing may be required, and to collect those data for analysis. In this study, the status of present programs was to be reviewed, and a thorough familiarity with methodology applied to previous efforts was to be obtained.

DATA ANALYSIS AND INTERPRETATION

Available data pertaining to solid waste management were to be reviewed and analyzed for accuracy, consistency, and utility. It was anticipated that data would not be sufficient to define the industrial waste and other special waste situations. Therefore, an Interim Report was included in the scope, which was to define the need for data in these particular areas.

After this project was underway, it was determined that data insufficiencies were present in all aspects of solid waste information and facility characteristics. Therefore, the scope of the Interim Report was modified to cover the complete area of data needs. Since subsequent data collection steps relate quite closely to other elements of the final Plan and Program, it was decided to include data requirements as a part of the principal report. Although an interim submission of this part of the report was made, these elements once considered to be a special report became a major part of the principal report.

THE STATE ROLE

Determination of the proper Role or scope of functions of the State Government in the overall problem of solid waste management is the most important policy decision to be made. It directs and provides a basis for every element of the Plan and Program.

Factors which were to be studied for their impact on Role determination were:

1. The existing Role, as evidenced by the combined scope of functions of all State agencies which have an involvement with solid waste management.

2. The status of coordination, cooperation, progress, and implementation of appropriate methods presently used in New York State, and the effect on the need for a different State Role than presently employed.

3. Financial impact of the overall solid waste problem in the State, and the effect that State participation might have on that impact.

4. Extent of common needs which can best be solved by a level of government which is common to each entity which reflects the need.

SERVICE AREAS

Based on known economies of scale and on experience in various areas throughout the country, it was anticipated that long-range planning would include provision for cooperative solid waste ventures between local governmental entities. To avoid confusion with existing Regional efforts which might not be appropriate to regions defined by solid waste needs, the term "Service Areas" was chosen to represent these geographical subdivisions of the State.

A mathematical model was proposed to aid in Service Area definition, but development of the model was deferred to subsequent phases of study. It was still desirable, however, to have a preliminary definition of whether the Service Area concept did apply and how these areas might be defined.

Therefore, criteria for Service Area delineation were to be developed, and a preliminary definition of the most probable boundaries was to be made.

PLAN AND PROGRAM

The results of the investigation were to be translated into a Plan and Program for the State of New York, and were to cover subsequent study needs, data collection efforts, legislative needs, and the approach to initiating the full scope of functions defined by the State Role.

The Plan and Program along with discussion of the study effort was then to be incorporated into a report.

PUBLIC RELATIONS

It was stipulated that ROY F. WESTON would assist the State in appropriate efforts to publicize the various elements of the Plan and Program, and to identify those areas of implementation which could benefit by advance public relations.

Specific tasks under this general objective were:

1. Prepare a summary of the final project report which could serve as the basis for a popular version of the report for general distribution.

2. Develop a plan for a land reclamation project which would employ sanitary landfill, and provide artistic renderings to illustrate the plan. Such materials would be used as appropriate to portray the beneficial aspects of the sanitary landfill method of solid wastes disposal.

The results of this Phase I study are presented in the following chapters, along with discussion of the findings.

CHAPTER FOUR

BACKGROUND AND OUTLINE

INTRODUCTION

Development and implementation of a solid waste program for New York State cannot be accomplished by examination of solid waste alone. Considerations of population, industrial and agricultural activity, transportation, geography, political organization and attitudes, sociological implications, and financial resources, all strongly affect the solid waste problem and development of solutions. In any of these cases there could be contraints which would limit the flexibility of program implementation. Each of these areas must be examined to make sure that sufficient data are available, to determine the need for and priority of supplemental investigations, and to see if any significant parts of the program development are being duplicated by other agencies.

This part of the report, then, is concerned with the underlying physical, demographic, political, and economic considerations. Each Chapter is summarized in the following sections.

POPULATION AND DEVELOPMENT PATTERNS (CHAPTER FIVE)

The discussion centers on two major topics: 1) Patterns of Development, and 2) Population Growth and Change. The first reviews the historic and future growth patterns in the State of New York as a tool in guiding selection of disposal sites, transfer stations, and other handling facilities necessary to serve the shifting growth areas within the State. The importance of land use and zoning data in site selection for a landfill or other facility is stressed. Centers of activity and future development patterns are reviewed.

Discussion then turns to the current and future changes in population by Economic Development Areas (as defined by the Department of Commerce of New York State). Present and projected concentrations of population are presented, with appropriate maps, as a basis for development of waste load distribution.

INDUSTRIAL AND AGRICULTURAL DEVELOPMENT (CHAPTER SIX)

The amount of solid waste generated by industrial and agricultural activity is a significant portion of the total solid waste load of New York State. This chapter examines the State on the basis of the Economic Development Areas and identifies existing and projected major industrial employment and agricultural activity levels and concentrations. Trends are also noted and discussed. Location of the centers of activity is important in determining the concentrations of waste generation and the implications for area-wide solutions. The data presented in this chapter were collected and projected as a specific part of this solid waste study. The techniques used in deriving this material are presented and discussed in Chapters Fourteen and Fifteen.

TRANSPORTATION (CHAPTER SEVEN)

This chapter focuses on the historic growth and detailed characteristics of transportation means - highway, rail, and water - most appropriate for the handling of solid waste. Each is discussed with regard to current and future networks and the sufficiency of the networks. Then each is reviewed in terms of the existing characteristics, methods, practices, and constraints, and with regard to the potential future developments in their system characteristics. Finally, the potential system capabilities and limitations are explored to determine the role each might play in an inter-related transport network for the handling of solid waste. The impact which these factors could have in determination of a one-mode, bi-modal, or tri-modal system is critical in the development of a feasible solid waste plan.

PHYSICAL AND NATURAL CONDITIONS (CHAPTER EIGHT)

Physical and natural conditions are important considerations in locating and operating waste disposal sites and related facilities. This chapter discusses the implications of geology, topography, hydrology, and meteorology in locating and operating a successful disposal operation. The geology section indicates, in general, which geologic factors are relevant to selection and operation of a good landfill. The influence of topography covers site elevations, slopes, drainage, and the determination of the type of landfill operation, i.e., area method or trench method. Hydrology is an important component in site selection because of the danger of polluting the ground or surface waters; proper drainage patterns have to be established and maintained. The section on meteorology is concerned with the effects of weather on landfills and other solid waste disposal facilities; cold, wet, and windy weather can all affect the acceptability of a site or its operation unless proper precautions are taken. The final section is an outline of natural and physical conditions in various parts of New York State.

STATE AGENCIES AND LEGISLATION (CHAPTER NINE)

The political and legal arena within which implementation must take place and the feasibility of change are important to successful development of a State-wide solid waste management plant. This chapter looks first at the existing legislation on which elements of the current state solid waste program are based. Strengths and weaknesses are discussed, and directions for potential change and improvement are reviewed. Next, the action areas and responsibilities of the State agencies currently involved in the solid waste program are presented, with commentary as to their applicability and effectiveness.

After these first two discussions, the current allocation of responsibilities between state and local agencies is reviewed, and the feasibility of obtaining the proper balance between local and State power as a means of achieving a more integrated State-wide solution of the solid waste program is examined. Finally, the problem area of enforcement and control is reviewed in terms of State/local powers and of the inadequacy of the current legislation, regulations, and enforcement methodology. Potential methods for improving this program element are briefly discussed as a basis for plan development.

POLITICAL, SOCIOLOGICAL, AND FINANCIAL FACTORS (CHAPTER TEN)

This last chapter of Part Two covers three other important factors which have a decided impact on development and implementation of the solid waste plan. The first of these is the political and sociological climate in which planning and execution must occur. The second factor is inter-municipal cooperation. Although numerous laws and legal vehicles exist for inter-municipal cooperation in solid waste disposal, very few municipalities have chosen this path as a solution to the problem. The nature of the existing legislation is reviewed with commentary on the reasons for lack of success and on the type of inducements or programs which may be appropriate to achieve the necessary cooperation. The final section of Chapter Ten is a brief review of the economics and finances of municipalities and of the State with regard to their ability to implement solid waste collection, transportation, processing, and disposal plans. A discussion of the reasons for what is currently a tight financial situation and of several potential means for effectuating proposals despite these current problems closes the presentation in this chapter.

CHAPTER FIVE

POPULATION GROWTH AND DEVELOPMENT PATTERNS

INTRODUCTION

Population in the state of New York is projected to increase by almost 40 percent in the next 30 years, from approximately 18 million people in 1965 to nearly 25 million by 1995. Because of the impact of population growth and land use on waste generation and its ultimate disposal, it is important to know the present and future location and relative scale of these population increases and changes in land use in order to develop a relevant State-wide solid waste management plan. The patterns of growth in New York are related to the historic development of the State along major transportation corridors. These patterns have been affected by changes in transportation technology, by changes in transportation routes, by the development of natural or imported resources, and by the consumption of available developable land. What had been a tightly defined and contained population growth pattern within the strict confines of the Hudson and Mohawk River Valleys, is now beginning to be distributed outward along new valleys and transportation corridors.

Land use information for the entire State is currently being compiled by the Office of Planning Coordination. Aerial photo-surveys have been flown to collect land-use information for the State of New York, and maps for approximately 28 counties have been completed. Land use and zoning data are important in selecting waste disposal sites and in ensuring their compatibility with present and future activities in the surrounding area.

HISTORIC DEVELOPMENT AND POPULATION GROWTH

Early development took place along the rivers and at major sea and lake ports of New York State. Mills and factories were located there because of the transportation potential and the cheap source of power, and cities grew where these mills and factories were located. Steam power and, later, electricity promoted development of urban concentrations at other locations. People shifted from farm to city as mechanization of agriculture and increasing farm size reduced the viability of the small family farm, because of economic pressure.

The early centers established in the Hudson and Mohawk River Valleys increased in size, and the extension of the Erie Canal reinforced the already extant New York-to-Albany and Albany-to-Erie development corridors. The State population grew from 1.4 million in 1820 to 3.1 million in 1850. Upstate cities along the Canal grew from small settlements to major urban centers - Buffalo, Lockport, Rochester, Syracuse, and Utica emerged as cities. Buffalo grew from a town of 5,000 in 1825 to almost 75,000 by 1855. New York City more than quadrupled in population in 30 years, going from almost 165,000 in 1825 to to 665,000 in 1855. With the advent of rail, the existing cities and the development corridor grew even more. The State increased in population from 3.9 million in 1860 to 6.0 million in 1890, and reached 10.4 million in 1920. The large influx of European immigrants provided an impetus to growth, especially in New York City, which grew most. New York City had 30 percent of the State's population in 1860 and 54 percent by 1920.

As a result both of the demand exerted by a growing urban population and the freedom offered by the development of electricity, the elevator, lightweight steel construction, and mass public transportation, changes in form and structure took place within the cities. Cities grew upward and outward. After 1930, the automobile exerted its influence on the urban form. A more scattered development pattern, with densities much lower than those which had been prevalent, emerged as the cities added suburbs and grew into metropolitan areas. From 1920 to 1950, cities continued to grow, although 1940 signaled the beginning of a faster rate of growth outside cities and villages in the suburban and exurban areas of towns. A major proportion of this increase, however, was still concentrated in the principal development corridors. By 1950, cities began to experience a small decline in population, while the surrounding towns and villages grew rapidly. The total State population had increased to 14.8 million people by 1950.

Since 1950 State population has continued to grow, increasing to 18.3 million by 1968. Nearly all of the population gain between 1950 and 1968 took place in the urban belts surrounding the central cities in metropolitan areas. These areas experienced an average of 70 percent gain in population. Heavy increases took place in the suburbs of New York City, especially in Nassau, Suffolk, Rockland, and Westchester Counties. Virtually all of the central cities experienced some population deline. The remaining sections of the metropolitan areas outside the urban cluster had an increase of 27 percent. Outside of the metropolitan areas, the growth was about 12 percent.

LAND USE AND ZONING CONTROLS

The importance of land use and zoning controls cannot be overstated in relation to disposal site development. Compatibility of the site with existing and future area development is critical from the standpoint of operations and efficiency, as well as from that of aesthetics and public acceptance. By right, a disposal site, as a public activity, can be located anywhere with regard to zoning, as long as it does not constitute a nuisance or hazard. However, zoning, when instituted as part of a comprehensive plan and program, may reserve for residential use land that may be most appropriate for disposal sites, and usually relegates disposal sites to industrial zones.

The location of sites is important in terms of proximity to existing land uses, but is even more important when related to future land use. Most people overlook the fact that a landfill basically is either a land reclamation operation or an interim use for a given tract of land. Therefore, it is essential to give careful consideration to future land uses in selecting a site and planning its operation. Depending on the intended final use of a site, on the projected land use activity for the surrounding area, and on the projected needs of the future expected population, the fill configuration and operating criteria must be established to be certain that the completed landfill can support structures if industry will eventually use the site, or that it has been contoured appropriately for a park or golf course if recreation is to be the ultimate use. If recreation is intended, then phasing of the landfill operation should be considered so that sections could be opened reasonably soon after the operation is initiated. This helps in public relations and can go a long way toward making acceptance of subsequent site location easier. Land use planning and implementation are discussed in detail in Chapter Eighteen.

As part of solid waste plan development, land use information is usually collected and plotted for two purposes: 1) to facilitate general calculation of waste material generated for current and future conditions, and 2) to provide a guide for site selection. Unfortunately, achievement of the basic goal - collection, plotting, and tabulating - was not possible at this time, because the completion of State-wide land use data (existing and future) by the Office of Planning Coordination (OPC), a cooperating agency in the study, did not coincide with the schedule of this phase of the study. It will be available by the time detailed site selection is carried out in subsequent phases. Chapters Thirteen, Fourteen, and Fifteen describe how current and future waste loads were determined using existing and forecasted population, industrial employment, and agricultural activities. Thus, the first purpose was satisfied through the use of more sophisticated techniques. The second purpose will be satisfied through field survey and review of the planning document, as part of a site reuse model approach discussed in Chapter Eighteen of this report. When the completed land use information is available, OPC will forward it to the Division of General Engineering and Radiological Health for its use in other studies.

CURRENT STATE-WIDE DEVELOPMENT ACTIVITY

Manufacturing occupies a leading place in the State's economy. Outstanding laboratories and educational institutions, and the favorable environment for development and growth of research are important assets contributing to the industrial vitality of New York State. The future economic growth of the State is being actively stimulated by projects currently underway at over 1,300 industrial laboratories operated by private firms, schools, and the government. During 1967 and 1968, the State Commerce Department received reports of more than 900 major new or expanded manufacturing facilities being "planned, underway or completed" in the State; during the same year, more than 100 new or expanded research facilities were "planned, underway or completed".

Farm business, although over-shadowed by other segments of the State's economy, is still substantial. Individually, New York's farms have been increasing in size and efficiency, but the area under cultivation and the number of farms have declined. Increasing amounts of land previously devoted to farming have been taken over for suburban residential, commercial, and industrial projects in regions convenient to metropolitan areas. Other marginal farmland has reverted to pasture, brush, and forest lands. Land devoted to farming has been decreasing approximately 5 percent every five years. At present, approximately 19 percent of the State area is crop land, and 14 percent is open pasture land. Nearly half of the State's area is in forest land, both State and private; this percentage has remained approximately the same for several years.

CENTERS OF DEVELOPMENT ACTIVITY

Within the State there are several major development areas. The New York City metropolitan area (the city, plus Nassau, Suffolk, Westchester, Rockland, Sullivan, Putnam, Ulster, and Dutchess Counties) currently has 67 percent of the state's population. New York City's population is expected to be relatively stable through 1995, but a 58 percent growth is projected for the remainder of the metropolitan area. The Nassau-Suffolk district has been growing rapidly; between 1940 and 1960, vast stretches of farmlands and many exclusive estates were transformed into housing developments and flourishing communities, as the huge in-migration of population took place.

Rapid growth is still continuing, primarily in eastern Nassau and western Suffolk. Additional mammoth shopping centers are being constructed, and industrial construction is experiencing an unprecedented boom. The population growth in western Nassau is continuing, but at a slower rate. Suffolk County is also experiencing population growth generated by improved transportation.

The Westchester-Rockland district of the New York City metropolitan area is one of the fastest growing districts of the State. Between 1960 and 1966, Rockland County population increased at a faster rate than any other county except Suffolk. The Mid-Hudson district is emerging as an important commercial and industrial center. The area is also one of the leading agricultural regions in New York State, and is a glamorous vacation land, with the Catskill resorts, the Washington Irving country, Bear Mountain, West Point, Saratoga, and other recreation and historical attractions. The suburban and rural areas of Dutchess, Orange, Putnam, and Ulster Counties have been growing rapidly, with an overall population growth of 18 percent between 1960 and 1967. Part of the stimulus for this growth has come from industrial expansion in the Hudson River Valley, where Dutchess, Orange, and Ulster Counties are the centers of manufacturing activity. Orange and Sullivan Counties are the district's most important agricultural areas.

The Albany-North region has 8 percent of the State's total population. Population projections show a 25 percent increase for the Albany area and a 9 percent increase for the remaining areas. Population and industry are concentrated in the four-county Albany-Schenectady-Troy metropolitan area. Rural Warren, Washington, and Schoharie Counties are largely agricultural and vacation lands, with scattered but important industrial communities; manufacturing activity is concentrated in the cluster of Glens Falls, Hudson Falls, and Fort Edward, north along the Hudson River, and to a lesser degree near Saratoga Springs. The northern part of the region, about one-third of which is within the Adirondack State Park, is the least densely inhabited area of the State. Most of the northern area is rural, and population concentrations are small; Watertown with 33,000 residents (1960 Census) is the largest city, and other population centers are Plattsburg, Massena, and Ogdensburg.

The Syracuse-Utica-Binghamton region has approximately 10 percent of the State's population. Population projections indicate a minimum of 28 percent growth in the major urban areas of the region and a 16 percent increase in the other areas. The Mohawk Valley area of this region is an area of physical and economic contrasts. The southern portion is highly industrialized, and the northern section is far less populous and is partly within the Adirondack State Park. Population and industry are concentrated in and near Utica and Rome. Smaller centers along the valley include Herkimer and Ilion in Herkimer County, Gloversville and Johnstown in Fulton County, and

Amsterdam in Montgomery County. Broome County is the major industrial and population center of the southern part of this region, and Delaware, Otsego, and Chenango Counties are the chief agricultural areas. Manufacturing is concentrated in Broome County, mostly in and around Binghamton. The Syracuse area completes this region. Population and industry in this area are concentrated in Onondaga County and in Syracuse, its largest city. Cayuga and Madison are the main agricultural counties of the area. Elmira, in Chemung County, and Corning, in Steuben County, are also centers of industrial activity.

The Buffalo-Rochester region has aoproximately 16 percent of the State's population. A 30 percent increase is forecast for the major urban areas and a 13 percent increase for the other areas. The Buffalo area of this region is the largest industrial and commercial center in upstate New York. Manufacturing is concentrated in Erie County (Buffalo metropolitan area), where one-third of the State's 1965 output of transportation equipment was manufactured. Dairying is an important activity in Chautauqua and Cattaraugus Counties, and Chautauqua County is also noted for its vineyards. The famous Niagara Fruit Belt, located in the northern section of the area, is one of the leading fruit producing areas of the State. The Rochester area of this region is famous both for its manufactured goods and its farm produce, and is the second most populous area in upstate New York. Monroe County is the industrial center of the area. Wayne County ranks second in the State in agricultural activity, with other important agricultural counties in this area being Wyoming, Genesee, and Ontario.

POPULATION GROWTH AND CHANGE BY ECONOMIC DEVELOPMENT AREAS

NEW YORK CITY AREA

Made up of Bronx, Kings (Brooklyn), New York (Manhattan), Queens, and Richmond (Staten Island) Counties, this area has one of the largest concentrations of population in the world. Population is projected to increase, but at a slower rate. In 1965, this area had 45 percent of the State's population, but by 1995, its share will decrease to 34 percent.

Bronx, Kings, New York, and Queens house the majority of the area's population (97 percent). This share is projected to decrease slightly to 93 percent because of projected losses in Kings and New York Counties and the population growth expected in Richmond County. Kings County has the largest individual share of the area's population, some 34 percent. Queens, New York, and Bronx follow with 24, 20, and 19 percent, respectively. The projected distribution of population remains essentially the same through 1995, with only slight percentage changes for each of the four principal counties. Richmond should double in population, but this increase is small compared to the projected change of about 1.1 million people in the four more populous counties.

NASSAU-SUFFOLK AREA

This two-county area is among the fastest growing and most dynamic areas in the State and in the nation. The area experienced substantial in-migration during 1940-1960, and the rapid growth is continuing, primarily in eastern Nassau and western Suffolk. Nassau County is the most populous county in the State outside of New York City, despite the fact that it is one of the smallest in area. The area's 1965 population was nearly 13 percent of the State's total. By 1995, this ratio is expected to increase to over 19 percent.

At the present time 60 percent of the area's people reside in Nassau County, 61 percent of whom are in the 15 principal municipalities. Hempstead is the largest community with 40 percent of the population. By 1995, however, because of tremendous projected growth of some 210 percent in Suffolk County, the Nassau/Suffolk distribution will reverse, and Suffolk County will contain 63 percent of the area's population. Internally, the principal Nassau County municipalities will gain population by 1995, but population in the suburban and rural areas will grow at a faster rate. The dramatic population growth in Suffolk will take place around Babylon and Lindenhurst in the western half of the county.

WESTCHESTER-ROCKLAND AREA

This Economic Area, composed of Rockland and Westchester Counties, is also one of the fastest growing areas in the State. In 1965 the area's population was nearly 6 percent of the State total, and is projected to increase to nearly 8 percent by 1995.

Westchester County accounts for 82 percent of the area population, with 61 percent located in the principal cities and villages. Although an increase in population is forecasted, Westchester's share of the area is projected to decrease to 75 percent by 1995. This is because Rockland County's population is growing at a very rapid rate. From 1960 to 1968, Rockland's population grew faster than any other county in the State except Suffolk's. By 1995, Rockland's population is projected to increase to more than two and one-half times the present level. A large amount of this expected growth can be attributed to growth from New York City and adjacent New Jersey, as well as to "spillover" from Westchester.

MID-HUDSON AREA

Composed of Columbia, Dutchess, Green, Orange, Putnam, Sullivan, and Ulster Counties, this is another fast-growing area. Between 1960 and 1968, population increased by nearly 19 percent. The area currently has more than

4 percent of the State's population, and this relationship will probably increase beyond 6 percent by 1995.

Orange is the most populous county and accounts for 30 percent of the area's population, a share which is projected to increase to 38 percent by 1995 as the county population virtually trebles. Dutchess County is projected to experience almost the same rate of growth, to a 30 percent share of the area's population. Putnam and Ulster are both projected to grow significantly by 1995, although Ulster's share of the area population will be significantly lower because of its slow growth rate relative to the three other growth counties. In all four of the growth counties, a substantial majority of the population increase will take place in the suburban and rural areas while the principal cities generally lose population.

Columbia, Greene, and Sullivan Counties are only sparsely populated relative to the other four counties in the area. All three are projected to experience only moderate growth and ultimately contain only one-half of their present small (18 percent) share of the area population.

CAPITAL AREA

This area is made up of Albany, Rensselaer, Saratoga, Schenectady, Schoharie, Warren, and Washington Counties, and accounts for 4.6 percent of the State's population. This share is projected to increase to 4.9 percent by 1995. Population is concentrated in the four-county Albany-Schenectady-Troy metropolitan area, with 85 percent of the area population residing in those counties. Albany, Schenectady, and Troy each now contain from 40 to 50 percent of their respective county's population; however, that share in each case is projected to fall (to as low as 16 percent by 1995) as the suburban and exurban areas build up. The remaining principal cities and villages account for only 7 percent of the metropolitan area population.

Schoharie, Warren, and Washington Counties are largely rural and account for approximately 15 percent of the area population. Although these three counties are projected to increase in population by 1995 (particularly Warren County), they will still lose 3 percent in their share of the area population. Glens Falls, the principal municipality in Warren County, is projected to lose some population, with the remainder of the county increasing by over 40 percent.

NORTHERN AREA

This area, composed of Clinton, Essex, Franklin, Jefferson, Lewis and St. Lawrence County, is the largest of the twelve Economic Areas, but is the least densely populated, with much of the region (34 percent) located within the Adirondack State Park. The total population of the area was a little more than 2 percent of the State total in 1965, and projections indicate a small decrease in this share by 1995. Population concentrations are small - Watertown (1965 Population 32,400) is the largest city. Other population centers are Plattsburg in Clinton County and Massena and Ogdensburg in St. Lawrence County.

St. Lawrence County has the largest share of population (31 percent) of this area, and this is projected to increase to 36 percent by 1995. Clinton and Jefferson Counties are next with 20 and 22 percent respectively, which will change to 23 and 18 percent, respectively, by 1995 because of more rapid growth in Clinton. Essex, Lewis, and Franklin Counties had respective 1965 area population shares of 9, 6, and 12 percent, which are forecasted to change to 8, 5, and 11 percent by 1995. This loss in share of area population is part of the expected phenomenon of a shift in the population concentration to the waterway boundaries of the region.

MOHAWK VALLEY AREA

In this Economic Area (Fulton, Hamilton, Herkimer, Montgomery and Oneida Counties) population is concentrated in and near Utica and Rome. Smaller centers along the valley include Herkimer and Ilion in Herkimer County, Gloversville and Johnstown in Fulton County, and Amsterdam in Montgomery County. The area has approximately 2.6 percent of the State's population, and this ratio is projected to decrease slightly by 1995.

Oneida County accounts for the largest share of population in the area with 61 percent. Rome and Utica together contain 55 percent of the county's population, a distribution which will change by 1995. By that time, although Rome will have gained population, Utica will have lost, and the bulk of the population growth will have occurred in the surrounding rural and suburban areas, which will then account for 60 percent of the county population. Herkimer, the second largest county in population, will grow to a limited extent with the same shift of rapid population growth from the city to surrounding areas. Population in Montgomery County is projected to increase only a modest amount in the suburbs and rural areas while Amsterdam loses a significant number of people, resulting in an overall population loss by 1995. Fulton County is projected to grow only a modest amount with a significant increase in the suburban and rural areas and a significant decrease in the population of Johnstown and Gloversville. Hamilton County's population (less than 1 percent of the area population) is projected to remain stable.

SYRACUSE AREA

This area is made up of Cayuga, Cortland, Madison, Onondaga and Oswego Counties and accounts for 4 percent of the State's population. This share is projected to increase only slightly, to about 4.5 percent by 1995.

Population is concentrated in Onondaga County and in Syracuse, its largest city. Nearly 30 percent of the area's people live in Syracuse, and another 32 percent live in the remainder of Onondaga County. This county contains 62 percent of the area population; the remainder is distributed among the other counties in the following proportions: Oswego, 13 percent; Cayuga, 11 percent; Madison, 8 percent; and Cortland, 6 percent. Projections indicate that Onondaga will increase its share to 64 percent by 1995. The other county shares will be redistributed to some extent and are projected to be: Oswego, 14 percent; Cayuga, 8 percent; Madison, 9 percent; and Cortland, 5 percent. Therefore, Onondaga, Oswego, and Madison increase their shares slightly, while Cayuga and Cortland decrease theirs. This redistribution is projected to take place coincident with a population increase in all counties.

ROCHESTER AREA

The Rochester Area is composed of nine counties - Genesee, Livingston, Monroe, Ontario, Orleans, Seneca, Wayne, Wyoming, and Yates. This is the second most populous region in upstate New York. In 1965, the area had almost 6 percent of the State's total population, and projections indicate that this share will increase slightly by 1995.

Slightly more than 63 percent of the area's people live in Monroe County, and 49 percent of these reside in Rochester. By 1995, that distribution is expected to shift with an increase of population outside Rochester of almost 50 percent, and a decline of Rochester's population of some 9 percent. The net effect will be a slight gain in Monroe's share of the area's population. The remaining counties in this area all have relatively small shares of the population, ranging from a high of 7.2 percent in Wayne County to a low of 1.8 percent in Yates. Wayne's share will increase slightly to 8.2 percent in 1995, while the remaining counties all lose in terms of relative share, although generally growing in absolute population.

BUFFALO AREA

This area, consisting of Cattaraugus, Chautauqua, Erie, and Niagara Counties, accounts for 8.8 percent of the total State population. Projections indicate that this ratio will decrease slightly by 1995. Erie and Niagara Counties make up the Buffalo metropolitan area, and have 85 percent of the area population. This share is projected to increase. Buffalo and the other principal cities and villages in the two counties account for nearly 50 percent of the area's population; less than 42 percent of the people currently reside outside the principal cities and villages. This city/rural distribution is projected to change, however, in both counties, with Buffalo losing the greatest relative share of population to surrounding suburbs and developing towns.

In Cattaraugus and Chautauqua Counties, which are less densely populated, at least 60 percent of the population currently resides outside the principal cities, a distribution which is projected to continue. The two counties together presently account for only 15 percent of the area population, and this share is projected to decrease slightly to around 13 percent by 1995 in spite of an expected 13 percent increase in absolute population.

ELMIRA AREA

Allegany, Chemung, Schuyler, Steuben, and Tompkins Counties, which comprise the Elmira Area, account for 1.9 percent of the State's population, a share which is expected to remain relatively constant through 1995. Centers of population are not as concentrated in this area. Elmira, Ithaca, and Corning are the largest cities. Chemung County contains 31 percent of the area population and Steuben County, 29 percent. Chemung's share will increase only slightly by 1995, while Steuben's share declines to 25 percent. At the same time, Tompkins County's share of the area population is projected to increase from 22 to 28 percent, following the trend of a shift of the population concentration to suburban and exurban Tompkins County, with a concomitant loss of population for Ithaca. Chemung and Steuben Counties will experience the same trend, with a rapidly increasing suburban-exurban population coupled with a population loss in the principal cities.

BINGHAMTON AREA

This area is made up of Tioga, Broome, Chenango, Otsego, and Delaware Counties. The area's population is 2.3 percent of the total State population, and projections from the Office of Planning Coordination indicate this ratio will remain constant. Broome County is the major population center, with over one-half of the area's population concentrated in the "triple cities" of Binghamton, Endicott, and Johnson City; Binghamton, the largest of the three, accounts for one-third of the county's 1965 population, although this share is projected to decline to just over 20 percent by 1995. The population outside the three cities, currently 50 percent of the county total, is projected to increase to almost 70 percent by 1995, following the general trend of population increase outside central cities accompanied by a decrease of central city populations.

Chenango and Delaware Counties are projected to lose a small share of the area population because of a loss in absolute population, while Tioga County is projected to increase its share of area population because of a substantial growth. Otsego County is projected to lose a small share of the area population; Oneonta, the principal city, is projected to lose population, while the surrounding towns gain additional people.

SUMMARY OF TRENDS

New York State is still experiencing growth in all twelve population areas. This growth is projected to continue at a steady rate through 1995. Eighty-five percent of the State's people live in the seven metropolitan areas of the State. Six of these areas lie along the Hudson River - Mohawk Valley corridor, which stretches from the Great Lakes to the Atlantic Ocean. Area projections indicate that this development corridor will continue to receive a major portion of the population growth in the State, although a redistribution within this corridor is taking place. Tables 5-1 through 5-3, Figures 5-1 through 5-4, and Maps 1 through 3 present significant data and illustrations of trends.

New York City's share of State population, 54 percent in 1920 and 45 percent in 1965, is projected to decrease to 34 percent in 1995. Although this area is the single largest concentration of population, several other areas in the development corridor are projected to increase their share substantially. Nassau and Suffolk Counties will increase their combined share from 13 to 19 percent, while Westchester and Rockland are projected to increase their share by two percent. The Mid-Hudson Area will increase its share by two and one-half percent. Some of the Economic Areas (Buffalo, Elmira and Mohawk Valley) will lose a small percentage of their share by 1995. The remaining areas are projected to increase in population at a sufficient rate to allow them to maintain their present shares of State population by 1995. The pattern of low development activity and population levels in southwestern and northern New York State will continue and may be intensified to some degree.

Major changes are taking place within areas, as population in central cities declines and major growth takes place in suburban and rural areas adjacent to, but a greater distance from, principal cities and villages. In some cases this growth is shifting centers of area population from one county into an adjacent county. To a certain limited extent, the "Expansion in Linking-Valley Areas" discussed earlier has begun. The impact on solid waste management is that less free land will be available within or very close to principal cities, and the distance to large land areas suitable for regional disposal facilities is increasing.

The relationship of these population centers and growth areas, to concentrations of and developments in industrial and agricultural activity are discussed in Chapter Six.

Table 5-1

Total Population Projections by Economic Areas[1]

	Area Population and Percentage of State Total				
Economic Areas	1965	1970	1975	1985	1995
Binghamton	407,282 2.29%	421,422 2.25%	442,901 2.25%	499,569 2.27%	560,534 2.27%
Buffalo	1,556,567 8.75%	1,585,620 8.46%	1,644,694 8.36%	1,824,498 8.29%	2,013,229 8.14%
Capital	816,592 4.59%	860,326 4.59%	913,746 4.65%	1,046,435 4.76%	1,198,967 4.85%
Elmira	339,801 1.91%	354,365 1.89%	369,773 1.88%	411,485 1.87%	458,497 1.85%
Mid-Hudson	740,652 4.16%	844,054 4.50%	962,931 4.90%	1,264,237 5.75%	1,647,791 6.66%
Mohawk Valley	460,860 2.59%	475,293 2.54%	491,913 2.50%	541,792 2.46%	593,428 2.40%
Nassau-Suffolk	2,297,296 12.91%	2,610,254 13.92%	2,890,369 14.70%	3,700,980 16.82%	4,764,981 19.27%
New York City	7,996,241 44.94%	8,162,094 43.53%	8,233,476 41.87%	8,374,462 38.06%	8,487,248 34.33%
Northern	393,609 2.21%	404,211 2.16%	414,920 2.11%	451,282 2.05%	497,282 2.01%
Rochester	1,019,221 5.73%	1,091,044 5.82%	1,161,668 5.91%	1,328,531 6.04%	1,507,852 6.10%
Syracuse	727,056 4.09%	774,852 4.13%	829,341 4.22%	964,545 4.38%	1,112,086 4.50%
Westchester-Rockland	1,038,609 5.84%	1,165,672 6.22%	1,309,585 6.66%	1,596,064 7.25%	1,882,399 7.61%
STATE	17,794,146 100%	18,749,207 100%	19,665,317 100%	22,003,880 100%	24,724,294 100%

---

[1] Data provided by New York State Office of Planning Coordination.

Table 5-2

Total Population Projections by Counties[1]

Counties	Years				
	1965	1970	1975	1985	1995
Albany	284,601	303,461	326,511	381,466	445,717
Allegany	45,972	46,626	47,753	50,534	53,957
Bronx	1,522,322	1,554,648	1,575,527	1,608,150	1,639,180
Broome	222,039	231,397	245,226	280,183	316,482
Cattaraugus	82,042	81,960	82,090	83,978	86,959
Cayuga	76,603	77,954	79,550	84,286	88,626
Chautauqua	150,556	153,217	157,044	167,536	180,392
Chemung	103,768	108,202	113,133	127,987	142,274
Chenango	45,566	47,269	49,235	54,129	59,682
Clinton	80,550	85,544	89,637	100,565	113,649
Columbia	49,478	51,021	52,748	57,459	62,777
Cortland	44,108	46,027	47,848	53,200	61,059
Delaware	43,338	42,225	41,798	42,554	43,621
Dutchess	210,456	240,197	275,174	370,260	504,367
Erie	1,083,239	1,102,034	1,149,716	1,281,559	1,419,116
Essex	35,912	36,004	36,357	37,985	39,362
Franklin	45,471	45,333	45,140	48,111	53,377
Fulton	51,153	50,852	50,446	52,313	54,613
Genesee	57,349	59,788	62,308	70,330	78,726
Greene	32,529	33,408	34,422	37,115	40,173
Hamilton	4,204	4,199	4,213	4,260	4,264
Herkimer	67,991	69,358	71,143	76,475	81,497
Jefferson	88,514	87,390	86,073	86,992	90,445
Kings	2,704,456	2,724,680	2,697,452	2,649,057	2,605,936
Lewis	23,610	23,597	23,534	23,848	24,121
Livingston	47,641	49,986	52,475	58,754	65,984
Madison	56,899	61,362	67,551	83,806	101,534
Monroe	643,816	699,008	750,808	866,664	988,404
Montgomery	57,120	55,847	54,779	54,296	53,675
Nassau	1,386,983	1,444,150	1,510,834	1,678,840	1,791,288
New York	1,563,871	1,540,248	1,508,042	1,450,160	1,395,398
Niagara	240,730	248,409	255,844	291,475	326,762
Oneida	280,292	295,037	311,332	354,446	399,379
Onondaga	456,632	490,524	526,939	613,996	708,627
Ontario	72,500	75,696	79,707	89,685	99,812
Orange	223,050	268,452	323,932	459,018	619,685
Orleans	36,810	38,545	40,414	44,940	49,153
Oswego	92,814	98,985	107,453	129,257	152,240
Otsego	53,677	53,760	55,647	61,035	67,490
Putnam	41,873	53,142	66,764	99,680	144,551
Queens	1,945,864	2,046,931	2,119,601	2,233,128	2,301,353
Rensselaer	153,402	163,163	173,962	199,650	228,592
Richmond	259,728	295,587	334,824	433,967	545,321
Rockland	182,182	231,292	265,785	354,249	461,527
St. Lawrence	119,552	126,343	134,179	153,851	176,328
Saratoga	99,488	107,867	117,132	140,373	167,717
Schenectady	160,631	164,995	172,436	191,802	210,884
Schoharie	22,863	22,892	23,078	23,619	24,487
Schuyler	15,304	15,579	15,916	17,255	18,587
Seneca	33,535	34,499	35,362	37,720	39,925
Steuben	99,976	101,869	104,012	110,388	116,752
Suffolk	910,313	1,166,104	1,379,535	2,022,140	2,973,693
Sullivan	47,664	49,040	50,225	53,428	56,515
Tioga	42,662	46,771	50,995	61,668	73,259
Tompkins	74,781	82,089	88,959	105,321	126,927
Ulster	135,602	148,794	159,666	187,277	219,723
Warren	47,157	49,474	51,782	57,843	64,220
Washington	48,810	48,474	48,845	51,682	57,350
Wayne	73,159	78,695	85,063	102,247	123,263
Westchester	856,427	934,380	1,043,800	1,241,815	1,420,872
Wyoming	35,637	36,015	36,514	38,302	40,955
Yates	18,774	18,832	19,017	19,889	21,630
STATE TOTAL	17,794,146	18,749,207	19,665,317	22,003,880	24,724,294

---

[1] Data provided by New York State Office of Planning Coordination.

Table 5-3

Population Density Projections by Counties[1]

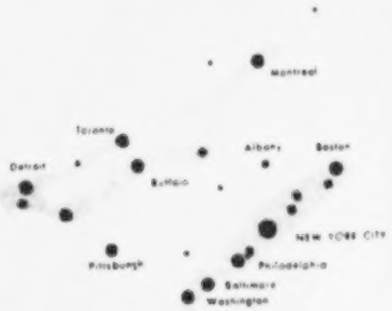
Counties	Number of Persons per Square Mile				
	1965	1970	1975	1985	1995
Albany	541	577	621	725	847
Allegany	44	45	46	48	52
Bronx	37,130	37,918	38,427	39,233	39,980
Broome	311	324	343	392	443
Cattaraugus	62	61	62	63	65
Cayuga	110	112	114	121	127
Chautauqua	139	142	145	155	167
Chemung	250	261	273	308	343
Chenango	50	52	54	60	66
Clinton	76	81	85	95	107
Columbia	77	79	82	89	97
Cortland	88	92	95	106	122
Delaware	30	29	29	29	30
Dutchess	259	295	338	455	620
Erie	1,024	1,042	1,087	1,211	1,341
Essex	20	20	20	21	22
Franklin	27	27	27	29	32
Fulton	103	102	101	105	110
Genesee	114	119	124	140	157
Greene	50	51	53	57	61
Hamilton	2	2	2	2	2
Herkimer	47	48	50	53	57
Jefferson	68	68	67	67	70
Kings	38,635	38,924	38,535	37,844	37,229
Lewis	18	18	18	18	19
Livingston	75	78	82	92	103
Madison	86	93	102	127	154
Monroe	954	1,036	1,112	1,284	1,464
Montgomery	140	137	134	133	132
Nassau	4,799	4,997	5,228	5,809	6,198
New York	67,994	66,967	65,480	63,050	60,669
Niagara	453	467	481	548	614
Oneida	229	241	254	290	326
Onondaga	611	657	705	822	949
Ontario	111	116	122	138	153
Orange	268	322	389	551	744
Orleans	93	97	102	113	124
Oswego	96	103	111	134	158
Otsego	53	53	55	60	67
Putnam	180	229	288	430	623
Queens	18,017	18,953	19,626	20,677	21,309
Rensselaer	231	245	262	300	344
Richmond	4,478	5,096	5,773	7,482	9,402
Rockland	1,035	1,314	1,510	2,013	2,622
St. Lawrence	43	46	48	56	64
Saratoga	122	132	143	172	205
Schenectady	776	797	833	927	1,019
Schoharie	37	37	37	38	39
Schuyler	46	47	48	52	56
Seneca	99	102	105	112	118
Steuben	71	72	74	78	83
Suffolk	980	1,255	1,485	2,177	3,201
Sullivan	49	50	51	55	58
Tioga	81	89	97	118	140
Tompkins	155	170	185	219	263
Ulster	119	130	140	164	193
Warren	53	56	58	65	72
Washington	58	58	58	62	69
Wayne	121	130	140	169	203
Westchester	1,933	2,109	2,356	2,803	3,207
Wyoming	60	60	61	64	68
Yates	55	55	55	58	63

---

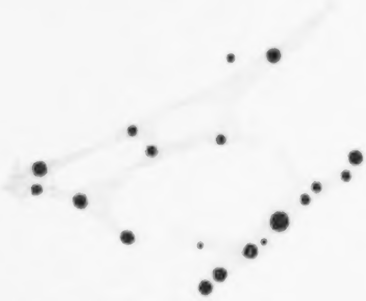
[1] Data provided by New York State Office of Planning Coordination

PATTERNS OF DEVELOPMENT; NEW YORK STATE

FIGURE 5-1


Montreal
Toronto
Albany
Boston
Detroit
Buffalo
NEW YORK CITY
Pittsburgh
Philadelphia
Baltimore
Washington

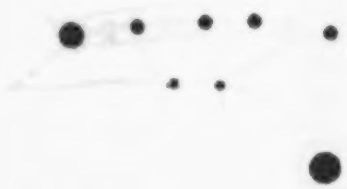
FORCES CONCENTRATING DEVELOPMENT



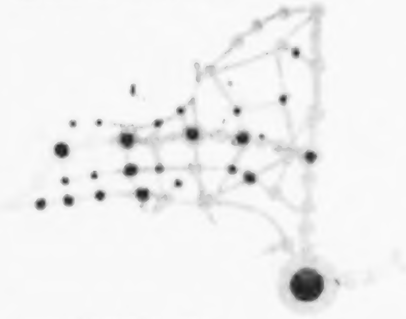
FORCES CONNECTING DEVELOPMENT

FORCES DISTRIBUTING DEVELOPMENT

EXPANSION OF METROPOLITAN AREAS



EXPANSION IN LINKING-VALLEY AREAS

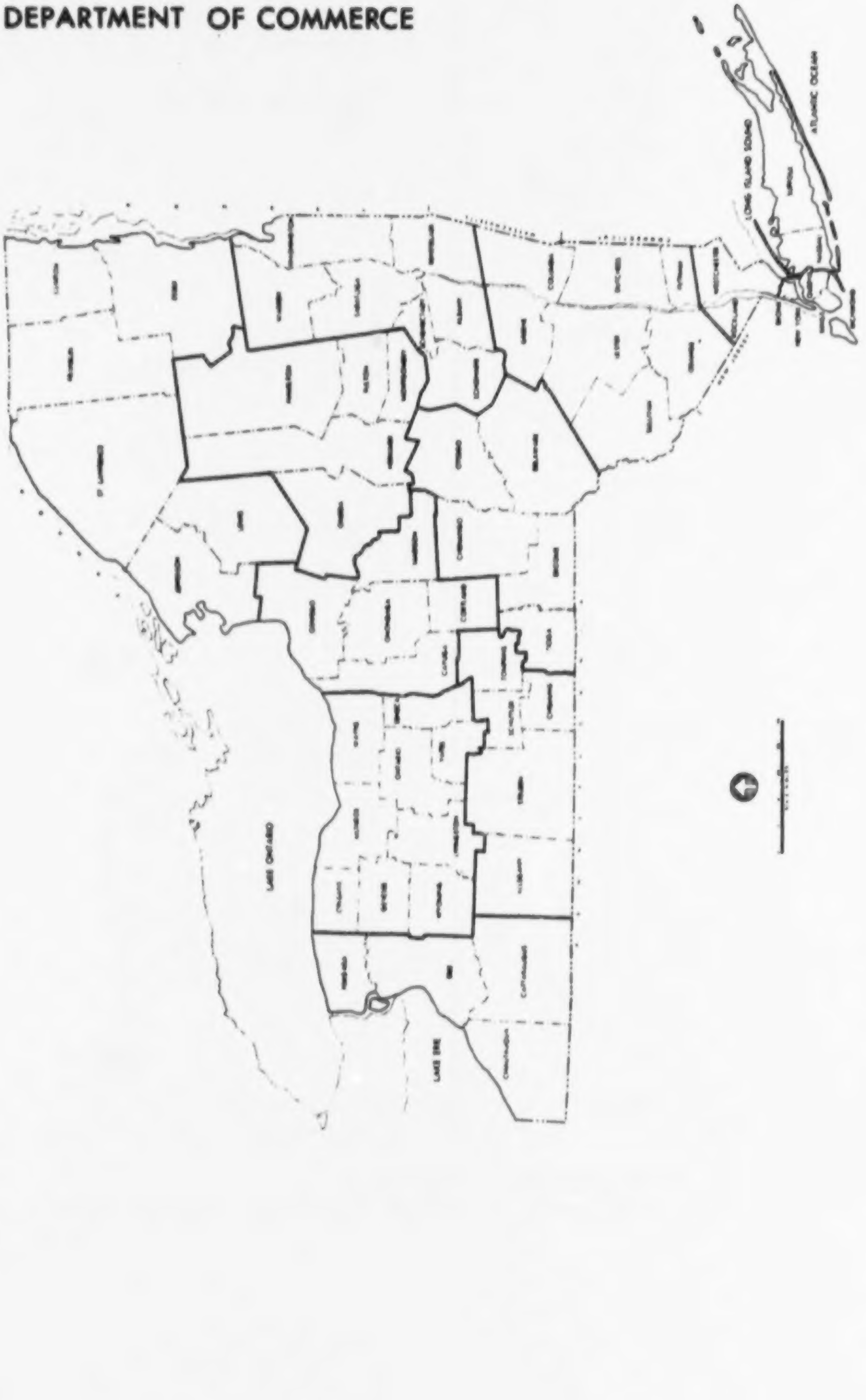


EXPANSION ON A STATEWIDE BASIS

SOURCE: CHANGE/CHALLENGE/RESPONSE: NEW YORK STATE OFFICE OF PLANNING COORDINATION

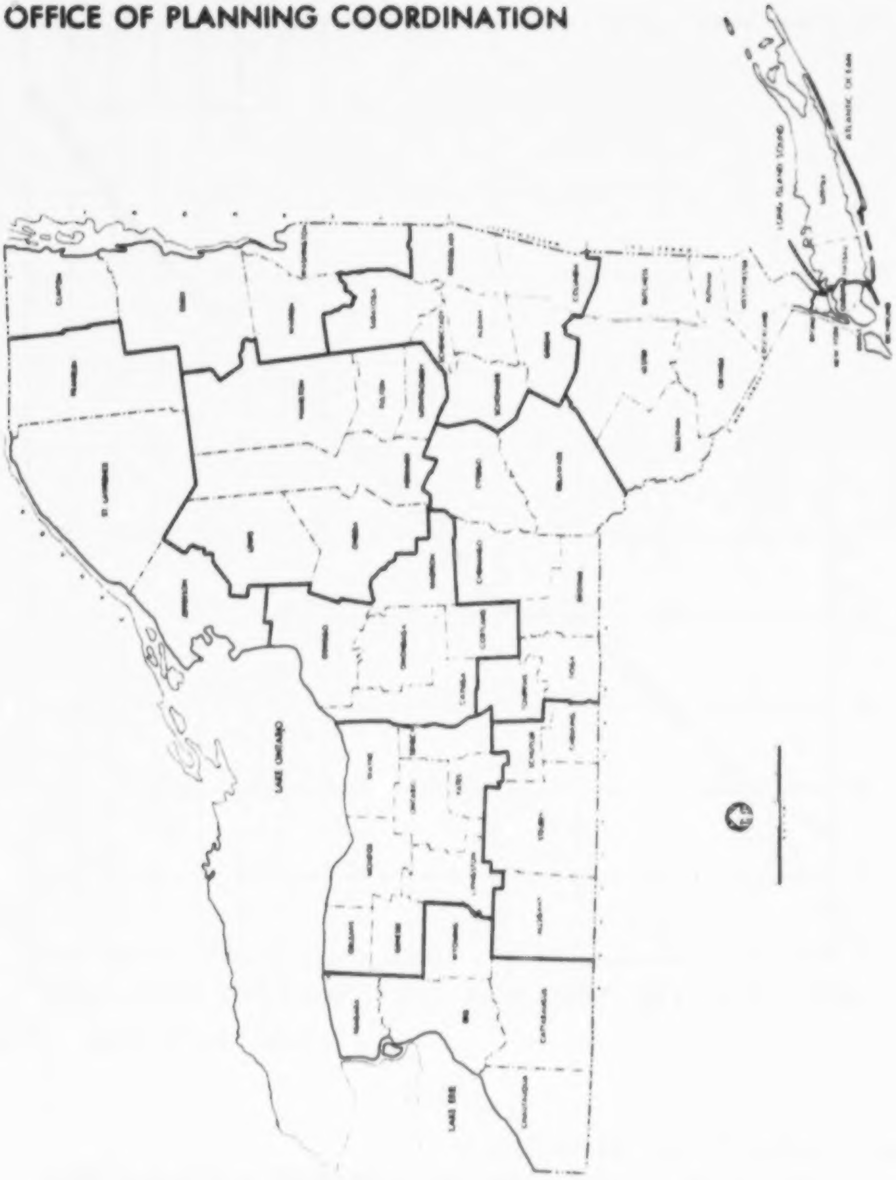
ECONOMIC AREAS:
NEW YORK STATE
DEPARTMENT OF COMMERCE

FIGURE 5-2


LONG ISLAND SOUND
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE

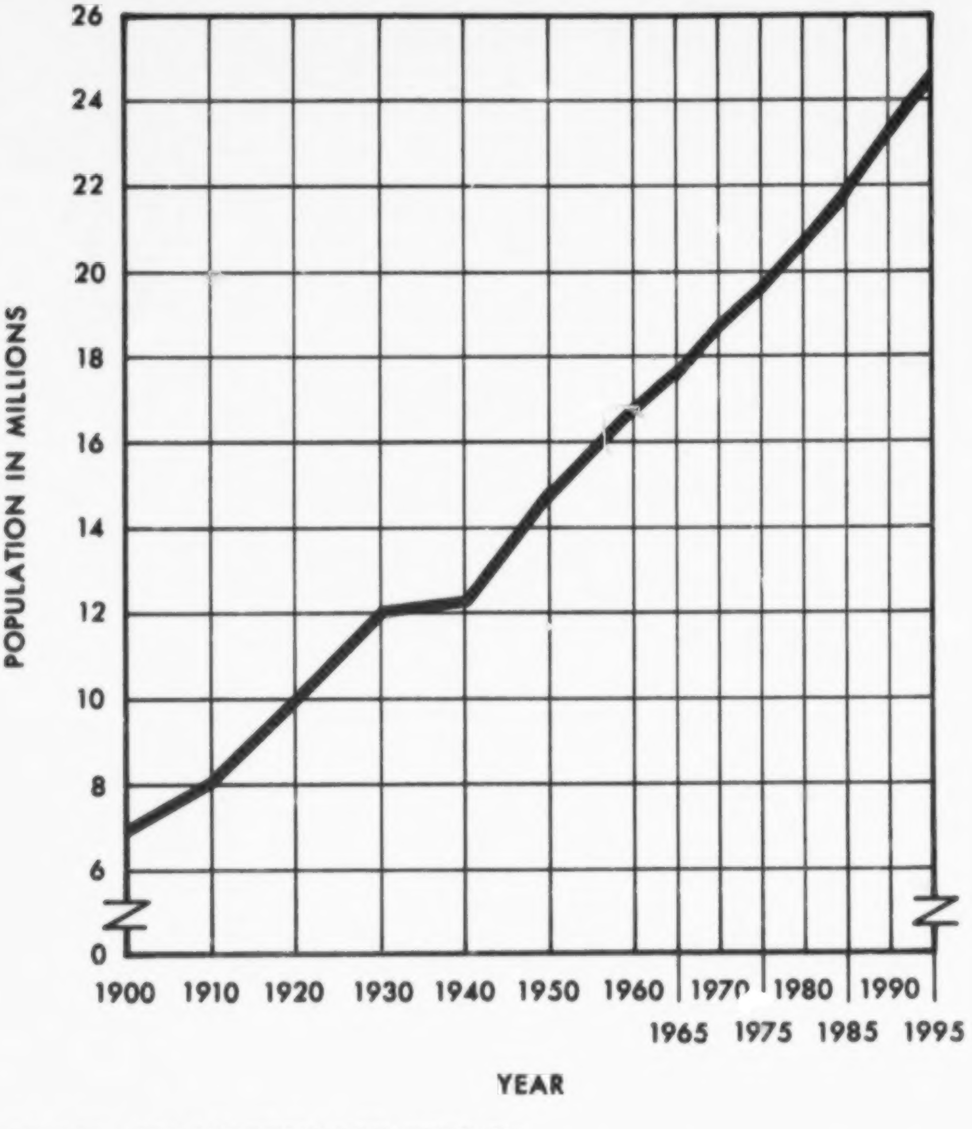
PLANNING REGIONS: NEW YORK STATE OFFICE OF PLANNING COORDINATION

FIGURE 5-3


LAKE ONTARIO
LAKE ERIE
LONG ISLAND SOUND
ATLANTIC OCEAN

POPULATION CHANGE:
NEW YORK STATE; 1900-1995

FIGURE 5 - 4



SOURCE: PROJECTIONS PROVIDED BY
NEW YORK STATE OFFICE OF PLANNING COORDINATION

CHAPTER SIX

INDUSTRIAL AND AGRICULTURAL ACTIVITY

INTRODUCTION

Not only are industry and agriculture two of the principal generators of solid waste, but the types and amounts of waste they generate are significantly influenced by the types and levels of activity. Therefore, an examination of the industrial and agricultural mix and activity levels in all parts of New York State is essential to development of any reasonable State-wide plan for solid waste disposal. In particular, locating the centers of activity is important in determining the concentration of waste generation and the implications for area-wide solutions. A data collection program, with projection of trends through 1995, was a specific part of this solid waste study. In this chapter, industrial employment and agriculture activity (number of employees in various significant industries; types of crop, livestock, and other agricultural activity; indications of intra-area concentrations and relative position of specific industry or agriculture activities within area and State-wide) are examined for each of the twelve Economic Development Areas used in the population discussion of the preceding chapter. The projection techniques used in deriving this material are presented and discussed in Chapters Fourteen and Fifteen.

EXISTING AND FUTURE INDUSTRIAL EMPLOYMENT AND AGRICULTURAL ACTIVITY

NEW YORK CITY AREA

New York City is the center of the largest and most concentrated industrial and consumer market in the world. Total manufacturing employment exceeded 818,000 persons in 1965.

Kings, Queens, and Bronx Counties house important segments of the population and provide substantial employment opportunities in manufacturing and trade as well. Richmond County has the smallest employment and accounts for only 1 percent of the total area employment.

Manufacturing is the area's major activity, and indeed, New York City is the largest manufacturing center in the nation. The manufacturing activity is characterized by a high degree of diversification, with a dominance of nondurable over durable goods production.

Over 60 percent of the manufacturing employees work in the four major industries. Apparel ranks first with 32 percent, followed by: printing and publishing, 15 percent; miscellaneous manufacturing, 9 percent, and food products, 8 percent.

Over one-half of the area's manufacturing activity is located in New York County (Manhattan). Eighty-five percent of the printing industry is here, as is 70 percent of the apparel industry's employees. The 1965 industrial employment density was over 18,000 employees per square mile. This will decrease to 17,500 by 1995. Approximately 70 percent of the employees in the metal products and machinery industries are in Kings and Queens Counties.

There is virtually no agricultural activity in this area. The small amount that there is takes place in Richmond County, where there is some dairy and row crop activity; this will show a slight increase by 1995.

Projections indicate a decrease in the number of employees in the apparel, printing, and food products industries. The area's percentage of the State's manufacturing employees is projected to decrease from the current 47 percent to 17 percent by 1995.

NASSAU-SUFFOLK AREA

This area is among the fastest-growing and most dynamic areas in the State and the Nation. In 1965, 75 percent of the area's 122,500 manufacturing employees worked in durable goods industries - principally aircraft, machinery, and instruments. One of every four manufacturing employees worked in the transportation equipment industry in 1965, and there was a similar share for the electrical machinery and instruments groups combined. The aircraft industry is the largest segment of the transportation equipment industry. The electrical machinery industry is the area's second largest manufacturing employer and accounts for approximately 14 percent of the manufacturing work force. Instruments is the third ranking manufacturing employer and accounts for 12 percent of the manufacturing work force.

Printing and publishing, non-electrical machinery, apparel, and fabricated metal products industries each employ between six and seven percent of the manufacturing work force. All of these activities are projected to grow, and will increase the area's percentage of the State's total manufacturing employees from the 1965 percentage (7.2) to 8 percent by 1995.

Suffolk County is the leading producer of farm products in the State. This activity is in field crops, forest products, and poultry, especially ducks. Suffolk County is also an important producer of potatoes, vegetables, and cut flowers. Field crop activity will decrease somewhat, but the other agricultural activities will show an increase.

WESTCHESTER-ROCKLAND AREA

The area's manufacturing is concentrated in Westchester County, where (in 1965) 85 percent of the area's 69,000 manufacturing employees worked. By 1995, this will decrease to about 70 percent.

In 1965, the leading manufacturing employers were non-electrical machinery, chemicals, electrical machinery, transportation equipment, printing, and apparel. Each employed approximately 8 to 12 percent of the area's total manufacturing employees.

The chemical industry is an important employer in both counties of the area, and is the leading employer in Rockland County. The area's largest food products firms are located in White Plains and Tarrytown (Westchester County). Westchester County is also an important center for apparel production.

Several large firms in other industries employ a substantial number of manufacturing employees. Transportation equipment manufacturing has several plants in the Tarrytown area. Printing and publishing is also represented with a plant in Chappaqua (Westchester County). The area's share of total State manufacturing employment was 4 percent in 1965, and this will decrease to 2.0 percent by 1995.

Agriculture is a relatively minor sector of the area's economy. However, Westchester County's dollar sales in nursery and greenhouses ranked third in the State in 1963. At that time, approximately one-third of the agricultural activity was in the livestock and livestock products groups, with poultry raising being the major component. Agricultural activity will increase only slightly by 1995.

MID-HUDSON AREA

This is one of the fastest growing areas of the State, and currently has over 62,000 manufacturing employees, concentrated in Dutchess, Orange, and Ulster Counties. Significant manufacturing growth has taken place in the electrical and non-electrical industries; approximately 90 percent of the employees of these industries work in Dutchess and Ulster Counties.

The apparel industry ranks third in manufacturing employment and accounts for 10 percent of the area's manufacturing employees. Half of this activity is located in Orange County, with another 40 percent located in Ulster and Dutchess Counties.

This area is one of the State's most productive agricultural regions. Sullivan County is the State's foremost poultry-raising region, and its share of the area's activity will increase significantly. Orange County is the State's third largest agricultural producer (based on total receipts), and will continue to be important. Three-fourths of total sales in 1967 were in livestock and livestock products. Ulster County ranks third in the State in the sale of fruits, but overall activity will decrease slightly by 1995.

Activity in apparel will increase from the current 3,600 employees to 11,000 employees by 1995. Non-electrical machinery activity is projected to decrease from 21,000 to 9,000 employees, while the electrical machinery industry is expected to grow ten-fold by 1995. The percentage of the State's manufacturing employees in this area will increase slightly from the current 3.6 percent to 4 percent by 1995.

CAPITAL AREA

Population and industry are concentrated in the four-county Albany-Schenectady-Troy metropolitan area. Warren, Washington, and Schoharie Counties are rural and largely agricultural and vacation land, but have scattered and important industrial centers.

Schenectady (Schenectady County) and Troy (Rensselaer County) are heavily industrialized, while Albany is somewhat less dependent on manufacturing. Manufacturing activity is also concentrated in the cluster of Glens Falls, Hudson Falls, and Fort Edward (Warren and Washington Counties).

Less than half of the area's 70,000 manufacturing workers are employed in the four largest industries, but three-fourths are employed by firms in Albany, Schenectady, and Rensselaer Counties. Electrical and non-electrical machinery groups are the leading industries in the area and employ approximately 30 percent of the manufacturing workers; activity in these industries is centered in Schenectady. Papermaking firms employ approximately 11 percent of the area's manufacturing employees, and are concentrated in Saratoga County. The apparel industry ranks fourth in employment and is centered in Rensselaer County. The stone, clay and glass industry employs about eight percent of the area's manufacturing employees. The major firms of this industry are mainly located in Albany County, and to a lesser extent, in Schenectady County. Much of the area's food-processing industry is also located in Albany County.

Dairying is the chief agricultural activity in the area. Field crops, forest products, and horticulture specialties comprise the major portion of the value of the crops produced in the area. Most of the agricultural activity is located in Washington County, with nearly 40 percent of the area's dairy activity located here. By 1995, Washington County will increase in its share of dairy activity, while Schoharie County's share will decrease somewhat. Washington and Schoharie Counties are among the top 100 dairying counties in the nation.

Projections show that the electrical and non-electrical machinery industries will have fewer employees, while the paper products industry will show an increase from the current 6,600 to 25,000 employees in 1995. Apparel activity will also show a decrease, and stone and clay products activities will increase slightly. In 1965, this area had 4 percent of the State's manufacturing employees, and projections indicate that this ratio will decrease to 3 percent by 1995.

NORTHERN AREA

This area is the largest in area of the twelve Economic Development Areas but is the least densely populated, with much of the region located within the Adirondack State Park.

The area is one of the State's most important agricultural areas and leads all other areas of the State in dairying. Over half of this activity occurs in Jefferson and St. Lawrence Counties. Lewis and St. Lawrence Counties are also the maple syrup center of the State. Dairy activity in Jefferson will remain at the same level, while St. Lawrence will decrease slightly, and Franklin will increase. Essex will experience a rise in row crop activity. Lewis County levels will remain the same.

Primary metals, printing and publishing, apparel, and non-electrical machinery were among the industries registering the largest gain in employment in the 1958-1963 period. In 1966, one-half of the area's 21,000 manufacturing employees worked in the paper and primary-metals industries, nearly two-thirds of them in St. Lawrence and Jefferson Counties. Industrial employment density in 1965 was 2.4 and 5.8 employees per square mile, respectively for these counties. Jeffersons's employment density is projected to increase to 70 employees per square mile by 1995, while St. Lawrence will increase only to 7.5 by 1995.

The production of paper and paper products is the major employer in three of the six counties. The area's second largest manufacturing employer is the primary-metals industry, which employs approximately one-fifth of the area's manufacturing employees.

Transportation equipment, food processing, and non-electrical machinery rank next in importance (measured in employment). Together, these industries employ approximately one-fifth of the area's manufacturing employees. Currently, the area has 1.3 percent of the total State manufacturing employees. This will increase to 5.4 percent by 1995.

MOHAWK VALLEY AREA

Population and industry are concentrated in and near Utica and Rome (Herkimer and Oneida Counties). Smaller centers along the valley include Herkimer and Ilion in Herkimer County, Gloversville and Johnstown in Fulton County, and Amsterdam in Montgomery County. Total manufacturing employment for 1965 in this area was 52,000.

The leather goods industry, which ranks first, is located mostly in Fulton County. The second ranking industry, non-electrical machinery, has its major firms located in the Utica area (Herkimer County). Electrical machinery, which is the third ranking industry, is concentrated in Oneida County, where about 90 percent of the industry's 5,700 workers are employed. These three major industries employ more than one-third of the total manufacturing employees of the area.

Electrical and non-electrical machinery employment is expected to increase substantially, while leather goods activity will decrease slightly.

The textile, primary metals, and food industries together employ approximately one-fourth of the area's manufacturing employees. The leading firm in the textile industry is located at Amsterdam (Montgomery County). The largest employer in the primary metals industry is located in the Rome area (Oneida County). The largest food industry employer is located at Canajoharie (Montgomery County). The area's percentage of total State manufacturing employees will increase from 3 percent to 7.4 percent by 1995.

Dairying is the most important agricultural activity in this area, and is concentrated in Oneida, Herkimer, and Montgomery Counties. Relatively little change is projected by 1995 in relation to both the area and the State.

SYRACUSE AREA

Population and industry are concentrated in Onondaga County, and in Syracuse, its largest city. Approximately three-fourths of the area's 78,000 manufacturing employees work in Onondaga County.

The electrical machinery industry ranks first in area employment and accounts for 27 percent of all manufacturing employees. Non-electrical machinery ranks second with 19 percent. Primary metals firms are the next largest manufacturing employer, followed closely by food processors. Each of these industries employs about eight percent of the area's manufacturing employees. Next in importance are transportation equipment, chemicals, and paper and paper products.

Non-electrical machinery manufacturing is concentrated around the Syracuse area (Onondaga County). The principal firm in electrical machinery manufacturing is located in Syracuse. Also located near Syracuse are manufacturers of chemicals, primary metals, food products, and transportation equipment. The leading food products firm is located at Fulton (Oswego County) as is also the largest firm in the paper industry.

The area's share of total State employment will increase from 4.5 percent to 9.5 percent by 1995. Electrical machinery is projected to triple in employment, while non-electrical machinery employment will increase by six-fold. Primary metals and food processing will double their employment.

Dairying is the leading agricultural activity in the area. Field crops rank second. Most of the activity is in Cayuga and Madison Counties, where it is projected to remain at the same level through 1995. Cortland County is noted for its maple syrup and dairy products, while Oswego County is highly noted for pears, onions, and lettuce.

Onondaga, Cayuga, Madison, and Cortland all rank among the top 100 dairying counties in the nation. Cortland County will increase slightly in dairy activity, but decrease in other agricultural activities. Madison and Onondaga will also experience slight decreases in agricultural activities.

ROCHESTER AREA

This is the second most populous area in upstate New York, and ranks first in agricultural income. Most of the agricultural activity is in crops and in livestock and livestock products. Major yields are dairy products, field crops, and fruit. Apples and cherries from the famous Lake Ontario fruit belt, which extends across the northern part of Wayne County, are the principal fruit crops. Wayne County ranks second in the State in agricultural sales; the other important agricultural counties are Wyoming, Ontario, Genesee, and Monroe. Projections indicate that the area will show an overall decline in agricultural activity; however, Genesee County will show a slight increase in row crops, and Wyoming will show an increase in dairying.

Between 1958 and 1963, the area's manufacturing industries were among the fastest growing in the State. Approximately 90 percent of the area's manufacturing takes place in the four-county Rochester metropolitan area (Livingston, Monroe, Orleans, and Wayne Counties).

Instruments, by far, is the leading manufacturing employer and employs over one-third of the area's 141,000 manufacturing employees. Nearly all of the firms are located in Rochester (Monroe County).

Electrical machinery ranks second, and non-electrical machinery, third. The electrical machinery manufacturers employ approximately 11 percent of the manufacturing work force. Film processing and related activities account for about 12,000 employees. The Rochester Area is the State's leading producer of apparel outside of New York City, and employs 8,800 persons.

Food processing, the largest industry group among the non-durables in the area, employs approximately 10 percent of the manufacturing employees. The firms in this industry are scattered throughout many small towns of the area. Some of the largest are located in Avon (Livingston), and Medina (Orleans). Currently, the manufacturing employees account for 8.2 percent of the State total, but this is projected to increase to 21.5 percent by 1995.

BUFFALO AREA

The Buffalo Area is the largest commercial and industrial center in upstate New York. Manufacturing is concentrated in Erie County, where two-thirds of the area's 198,500 manufacturing employees work.

In the Buffalo metropolitan area (Erie and Niagara Counties), which accounts for over 85 percent of the area's manufacturing activities, transportation equipment has registered one of the sharpest gains, with output increasing by 44 percent, (1958-1963). Erie and Niagara County firms in this industry (particularly producers of motor-vehicle parts) account for almost one-third of the State's output of transportation equipment. Employment in the field is projected to increase from the current 32,000 employees to 56,000 by 1995.

The Buffalo Area is noted for the production of durable goods, which in 1965 provided jobs for 70 percent of the area's manufacturing workers. Primary metals is the area's leading industry and accounts for nearly 18 percent of all manufacturing jobs in the area, and for half of the total employment in this industry in the whole State. The fourth largest steel mill in the nation is located at Lackawanna (Erie County). The transportation equipment industry, ranked second in the area, employs 15 percent of the manufacturing employees, mainly in Erie County. The non-electrical machinery, fabricated metals, food processing, electrical machinery, and chemical industries each employ between eight and ten percent of the area's manufacturing work force. Manufacturing of electrical machinery is one of the area's expanding industries; projections indicate that it will grow significantly from the current 18,000 level.

The chemical industry employs almost one-fifth of the manufacturing workers in Niagara County, and it is also an important employer in Erie County. Furniture manufacturing is Chautauqua County's most important industry and one for which the county has long been noted. Buffalo is one of the major grain-milling centers in the world.

Dairying is the leading agricultural activity in the area and accounts for 46 percent of all agricultural receipts. Over 70 percent of this activity is in Chautauqua and Cattaraugus Counties. Future activity is expected to decline. The Buffalo Area is also one of the leading fruit-producing regions in the State. The Niagara fruit belt is located in the northern part of the area, and the Chautauqua vineyards in the southern portion.

Primary metals employment is expected to increase in the future as are transportation equipment and machinery employment. Chemicals also will increase, but only slightly. The furniture industry will remain at the same level of employees. The overall percentage of the State's manufacturing employees will decrease from the current 11.5 percent to 10.4 percent by 1995.

ELMIRA AREA

Centers of industry and population are not as concentrated in this area. Elmira in the area's largest city, while Elmira Heights and Horseheads (in Chemung County) comprise the leading industrial center.

Industry is concentrated in Chemung and Steuben Counties, where over two-thirds of the Area's 42,000 manufacturing employees work. Durable goods manufacturers predominate and account for 82 percent of all manufacturing job-holders.

Non-electrical machinery is the leading manufacturing industry, and the stone, clay and glass industry ranks second. Combined, they employ over half of the total number of manufacturing employees, and non-electrical machinery itself employs nearly one-third of the total manufacturing work force. The largest of the firms in this category is located at Painted Post (Steuben County). Stone, clay and glass, ranking second, is located almost exclusively at Corning (Steuben County). The next three largest industries (by total employment) are electrical machinery, fabricated metal products, and food products, and together they employ one-fourth of the manufacturing work force included in the SIC categories. Electrical machinery ranks third, and the major employer is located in Bath (Steuben County). Much of the transportation industry is the production of fire fighting apparatus and is concentrated in Elmira (Chemung County).

The area's food producers include the vintners who make most of New York State's wine. The leading producers are located in Hammondsport (Steuben County). One of the largest food processors is located at Horseheads (Chemung County).

Livestock and livestock products, particularly dairying, account for three-fourths of the agricultural dollar volume. Field crops are another important agricultural activity, with much of this activity located in Steuben County. Potatoes are also an important agricultural product of this area.

All of the major industries are expected to grow and add employees, which in turn will increase the area's percentage of the State's manufacturing employees from the present 2.5 percent to 3.5 percent by 1995. Agricultural activity, except beef and chickens, is expected to decrease in activity.

BINGHAMTON AREA

Broome County is the major industrial and population center, while Delaware, Otsego, and Chenango are the chief agricultural counties. Over two-third of the area's 44,600 manufacturing employees worked in Broome County in 1965, and this is projected to increase to 92 percent by 1995. The three largest industries (electrical machinery, non-electrical machinery, and leather and leather-products) employ nearly 60 percent of all the manufacturing employees. The machinery industries (electrical and non-electrical) provide for the largest number of manufacturing jobs, each accounting for approximately 22 percent of the manufacturing employment. Projections indicate that employment in the electrical and non-electrical machinery industries will grow from the current level of 19,000 to 26,000 by 1995, while the leather products industry will experience a decline in employment from 7,000 to 4,400 by 1995.

Instruments and transportation rank fourth and fifth, respectively, with most of the activity located in Binghamton (Broome County). A decline in employment is projected for the instruments industry from the current 1,600 to 165 by 1995, while the transportation products industry is expected to grow to 67,000 employees from the current 3,200 employees. Food processing is another important manufacturing industry in the area; dairy products rank first within the industry.

Overall industrial employment is expected to increase to nearly 400,000 by 1995, and the area's percentage of the State's manufacturing employees will increase from the current 2.6 percent to 8.5 percent by 1995. Also projected is an overall decline in agricultural activity, with only the fruit and nut crop activities showing an increase. Most of the present agricultural activity is in dairy cattle with nearly 90 percent of the Area's activity in Chenango, Delaware, and Otsego Counties.

SUMMARY OF MANUFACTURING TRENDS

Projections indicate that, in general, upstate areas west of the Capital Area will increase their percentage of total State manufacturing employees, only the Buffalo Area will experience a decrease. In the New York City metropolitan region, the Mid-Hudson and Nassau-Suffolk Areas will increase slightly, while the remaining areas will experience decreases in their shares of total State manufacturing employees. The apparel industry will experience an overall State-wide decline in employment activity in 1995.

Table 6-1 presents industrial employment projections for the twelve Economic Areas from 1965 through 1995; Tables 6-3 and 6-4 present projected industrial employment and employment density, by county, for the same period. Maps 4, 5, and 6 portray the projected levels of employment density (State-wide) for 1970, 1985, and 1995. Figure 6-1 is a chart which indicates the expected direction of change in industrial employment and agricultural activity for each Economic Area.

Increased employment activity will occur principally in the transportation equipment, electrical and non-electrical machinery, fabricated and primary metals, stone and clay, rubber and plastics, chemicals, wood products, furniture, paper products, and printing industries. Some increase can also be expected in the meat processing, canning, and frozen food industries.

In the New York City Area, Queens County will increase its percentage of total area employment very slightly, through gains in non-electrical machinery employment. New York County will increase by a significant number the employees in the stone and clay products industry, which reflects a shift in emphasis from Kings, Bronx, and Queens Counties. Kings and Queens Counties will gain from a shift in employment in the fabricated metals industry from the Bronx and New York Counties. As a result, Kings County will increase slightly its percentage of total area manufacturing employees, while Bronx County's share will decrease.

Area-wide increases can be expected in the leather products industry, while decreases in employment will occur in the electrical machinery, printing, apparel, instruments, food processing, and paper products industries.

In the Nassau-Suffolk Area, Suffolk County will increase its share of the total area employment. Significant gains in employment will take place in nearly all the industrial activities. Nassau County in particular will gain significantly in the paper and printing industries. Nassau County will, however, experience a decline in employment in electrical machinery, transportation equipment, rubber and plastics, and canning.

In the Westchester-Rockland Area, Rockland County will increase its share of total area manufacturing employees. It will gain employees in the food processing, textiles, apparel, furniture, printing, chemicals, primary metals, fabricated metals, electrical machinery, and transportation equipment industries. Westchester will have more employees in the printing, chemicals, rubber and plastics, stone and clay products, and primary and fabricated metals. It will lose employment in food processing, apparel, electrical machinery, and instruments.

In the Mid-Hudson Area, Orange, Ulster, and Columbia Counties will increase their percentage of total area manufacturing employment. Significant area increases can be expected in fabricated metals, paper, rubber and plastics, printing, and non-electrical machinery industries. The stone and clay products industry employment will increase appreciably in Columbia County. Electrical machinery employment will also increase, mainly in Ulster County. An area-wide decline in employment in the apparel industry can be expected.

In the Capital Area, Rensselaer, Albany, and Warren Counties will increase their percentage of total area manufacturing employees. Increases will be in the field of printing and publishing, transportation equipment, fabricated and primary metals, chemicals, stone and clay products, and rubber and plastics products. Also indicated is a geographical shift of employees in the paper industry from Washington County to Warren and Saratoga Counties.

Employment emphasis in non-electrical machinery will shift from Schenectady and Washington Counties to Rensselaer. An overall area decrease in employment will occur in the apparel industry.

In the Northern Area, Clinton County will increase its percentage of total area manufacturing employees; a significant increase in chemical employment will account for this change. Jefferson County will increase substantially its employment in the instruments industry. Wood products employment will increase area-wide, while paper products and food processing employment will experience a general decline.

In the Mohawk Valley Area, Herkimer and Oneida Counties will increase their shares of total area employment. Significant increases will take place in transportation equipment and chemical products, especially in Oneida County, and in the furniture and non-electrical machinery industries in Herkimer County. Area-wide increases will also occur in the paper, printing, fabricated metals, and electrical machinery industries. Textile employment will experience a decline throughout the area.

In the Syracuse Area, Cayuga and Madison Counties will increase their shares of the total area employment. Cayuga County will add significant numbers of employees in the fabricated metals, and in the non-electrical and electrical machinery industries. Gains will also take place in the rubber and plastics, stone and clay products, leather, printing, apparel, and food processing industries. Onondaga County will add significant numbers of employees in the chemicals, and rubber and plastics industries. Other gains will be in the printing, primary metals, fabricated metals, non-electrical and electrical machinery, and transportation equipment industries. Area-wide losses will occur in food processing, paper and paper products, and wood products.

In the Rochester Area, Ontario and Genesee Counties will increase their percentage of total area employment. Livingston County will have greater employment in the food processing industry, and Genesee County will experience an employment increase in the transportation equipment industry. Monroe County will increase its employment in the instruments industry by a significant amount, but will have a lower percentage of total-area manufacturing employees. Area-wide employment increases will occur in the canning, non-electrical and electrical machinery, fabricated metals, paper, printing, stone and clay products, and chemicals industries. Decreases will occur in the rubber and plastics, frozen foods, and textiles industries.

In the Buffalo Area, Niagara County will remain at its current percentage of total area employees. Increased employment will occur mainly in the fields of primary metals, electrical machinery, frozen foods and chemicals. Erie County's percentage of area manufacturing employees will decrease, while

Chautauqua and Cattaraugus will increase their percentage of area employees, especially in fabricated metals, electrical machinery, transportation equipment, instruments, printing, and plastics. Declines can be expected in food processing and furniture products.

In the Elmira Area, Chemung and Allegany Counties will increase their share of total area employment. Area-wide employment increases will be significant in the fabricated metals, and electrical and non-electrical machinery industries. Other increases will be in the paper products, stone and clay products, food processing, and transportation equipment.

In the Binghamton Area, Broome County will continue to be the center of employment for the area and will add significant numbers of employees in the fields of non-electrical machinery and transportation equipment.

SUMMARY OF AGRICULTURAL TRENDS

Agricultural activity will experience a State-wide decline in activity by 1995. As shown in Table 6-2, which is a projection of agricultural acreage through 1995, eleven of the twelve Economic Areas are expected to experience a decline in the acreage devoted to agricultural activity, with a State-wide drop of more than 25 percent. Only certain agricultural areas and activities will increase. General declines can be expected in hogs, dairy cattle, horses, and Class 1, 4, and 5 field and row crops. (See Chapter Fifteen)

Some of the New York City Area's little agricultural activity can be expected to increase slightly. Horses, Class 1 and 2 fruit and nut crops, and Class 1 field and row crops will experience some growth activity.

The Nassau-Suffolk Area can expect increased activity in chickens, hogs, ducks, and in Class 1, 4, and 5 fruit and nut crops.

The Westchester-Rockland Area will increase agricultural activity in only hens and beef cattle, and in Class 4 fruit and nut crops (prunes and plums).

In the Mid-Hudson Area, several agricultural activities will experience increases. Hens and beef cattle will increase as will Class 4 and 5 fruit and nut crops, and Class 2 and 4 field and row crops.

The Capital Area will experience some increase in chickens and hens and in Class 1, 4, and 5 fruit and nut crops. Class 4 field and row crops will also increase in activity.

The Northern Area will increase some of its agricultural activity. Hens and dairy cattle, Class 2 and 4 fruit and nut crops, and Class 2 field and row crops all will experience some area-wide increase in activity.

The Mohawk Valley Area will have increased agricultural activity in chickens and in Class 1 fruit and nut crops (grapes, peaches and nectarines).

The Syracuse Area's only area-wide activity increase will be in chickens, although individual county activities might vary.

The Rochester Area will increase area-wide activity in beef cattle, Class 2 fruit and nut crops, and Class 2 and 4 field and row crops.

In the Buffalo Area, grape activity will increase, as will Class 3, 4, and 5 field and row crops.

In the Elmira Area, only chicken and beef cattle activity will increase on an area-wide basis.

In the Binghamton Area, the only projected agricultural activity increases will be in fruit and nut crops (Classes 1, 2, and 4, which include grapes, peaches, apples and plums). All other agricultural activities on an area-wide basis will decline.

Table 6-1

Total Industrial Employment Projections for Economic Areas[1]

Economic Area	Area Employment and Percentage of State Total 1965	1970	1975	1985	1995
Binghamton	44,587 2.60%	50,674 2.88%	67,784 3.68%	152,676 5.96%	392,675 8.63%
Buffalo	198,510 11.59%	218,690 12.44%	243,981 13.23%	322,984 12.62%	472,363 10.38%
Capital	69,602 4.07%	70,799 4.03%	75,562 4.10%	97,153 3.79%	147,510 3.24%
Elmira	42,239 2.47%	48,930 2.78%	59,306 3.22%	96,301 3.76%	173,042 3.80%
Mid-Hudson	61,928 3.62%	58,848 3.35%	63,359 3.44%	95,307 3.72%	181,541 3.99%
Mohawk Valley	52,185 3.05%	60,383 3.43%	26,834 1.46%	145,823 5.70%	332,720 7.31%
Nassau-Suffolk	122,511 7.16%	134,727 7.66%	153,123 8.31%	219,705 8.58%	363,403 7.99%
New York City	811,689 47.41%	759,017 43.14%	723,876 39.27%	701,757 27.41%	765,338 16.82%
Northern	21,591 1.26%	24,346 1.38%	31,432 1.71%	72,175 2.82%	247,382 5.44%
Rochester	140,668 8.22%	170,264 9.68%	213,987 11.61%	385,352 15.05%	976,274 21.45%
Syracuse	77,817 4.54%	91,158 5.18%	110,776 6.01%	187,303 7.32%	396,638 8.72%
Westchester-Rockland	68,869 4.02%	70,619 4.02%	73,446 3.98%	83,608 3.27%	101,615 2.23%
STATE	1,712,196	1,758,455	1,843,466	2,560,144	4,550,501

---

[1] Consultant's Analysis.

Table 6-2

Agricultural Activity Projections for Economic Areas[1]

Economic Area	Area Acreage and Percentage of State Total				
	1965	1970	1975	1985	1995
Binghamton	34,676 2.59%	27,629 2.26%	22,308 1.97%	15,203 1.50%	10,382 1.06%
Buffalo	168,062 12.55%	155,705 12.76%	148,460 13.14%	148,998 14.65%	170,834 17.37%
Capital	34,645 2.58%	27,559 2.25%	22,585 1.99%	16,871 1.66%	14,857 1.51%
Elmira	122,224 9.13%	106,393 8.72%	93,661 8.29%	74,832 7.36%	62,138 6.32%
Mid-Hudson	71,409 5.33%	65,251 5.34%	61,274 5.42%	58,373 5.74%	61,049 6.21%
Mohawk Valley	60,019 4.48%	54,883 4.49%	50,371 4.45%	42,898 4.22%	37,117 3.98%
Nassau-Suffolk	47,103 3.51%	41,699 3.41%	37,075 3.28%	29,768 2.93%	24,656 2.51%
New York City	108 < 0.1%	82 < 0.1%	69 < 0.1%	60 < 0.1%	74 < 0.1%
Northern	80,247 5.99%	70,444 5.77%	62,286 5.51%	49,894 4.91%	41,590 4.23%
Rochester	549,159 41.02%	515,434 42.25%	490,234 43.40%	461,472 45.35%	458,175 46.58%
Syracuse	168,834 12.61%	153,100 12.54%	139,636 12.36%	118,045 11.60%	101,868 10.36%
Westchester-Rockland	2,101 0.15%	1,749 0.14%	1,496 0.13%	1,183 0.12%	1,029 0.11%
STATE	1,339,000	1,220,000	1,130,000	1,018,000	984,000

---

[1] Consultant's Analysis.

Table 6-3

Total Industrial Employment Projections for Counties[1]

County	Years 1965	1970	1975	1985	1995
Albany	25,735	26,368	29,092	40,308	65,566
Allegany	5,942	8,609	12,412	26,709	59,589
Bronx	51,279	45,258	41,585	37,940	37,251
Broome	31,142	37,874	54,280	134,563	382,231
Cattaraugus	8,840	11,017	14,747	29,745	70,417
Cayuga	9,314	13,865	21,598	58,499	183,380
Chautauqua	20,547	23,164	27,259	39,855	62,930
Chemung	14,954	17,250	21,153	35,997	67,397
Chenango	5,085	5,534	6,585	10,392	20,648
Clinton	2,759	2,911	4,754	21,867	129,820
Columbia	4,838	5,898	7,830	15,841	36,388
Cortland	5,639	6,166	6,760	8,585	11,668
Delaware	4,587	2,992	2,427	2,636	3,910
Dutchess	22,028	15,499	13,045	15,422	28,735
Erie	134,923	145,147	158,289	195,885	255,773
Essex	1,092	833	810	1,188	2,624
Franklin	1,623	1,568	1,719	2,760	5,524
Fulton	8,415	7,833	8,040	8,650	9,400
Genesee	7,303	9,202	13,792	55,087	377,568
Greene	3,019	2,941	3,154	4,318	7,270
Hamilton	0	111	122	148	179
Herkimer	10,917	13,682	18,674	38,284	84,214
Jefferson	7,604	9,962	13,964	32,873	90,644
Kings	209,913	195,217	186,814	184,777	200,578
Lewis	1,748	1,199	1,045	859	733
Livingston	3,532	4,413	5,756	1,078	222
Madison	996	1,479	2,498	8,630	32,876
Monroe	109,111	134,183	169,165	280,796	494,025
Montgomery	7,176	6,337	6,050	6,595	8,729
Nassau	84,868	88,543	95,955	129,618	215,745
New York	421,311	395,170	376,344	361,919	404,585
Niagara	34,200	39,362	43,686	92,146	83,243
Oneida	25,677	32,425	43,683	92,145	230,196
Onondaga	54,098	61,503	71,036	99,850	51,479
Ontario	4,108	6,196	8,647	19,699	56,151
Orange	16,957	18,252	20,926	32,256	58,381
Orleans	912	1,007	1,113	1,368	1,693
Oswego	7,771	8,146	8,886	11,739	17,227
Otsego	1,182	1,646	1,640	1,673	1,757
Putnam	1,101	966	841	644	499
Queens	119,822	113,084	108,530	105,030	108,196
Rensselaer	8,617	9,140	10,281	14,439	22,835
Richmond	9,364	10,288	10,603	12,091	14,728
Rockland	9,781	11,685	13,743	11,883	30,939
St. Lawrence	6,765	7,873	9,141	12,628	18,037
Saratoga	7,855	8,402	8,948	10,585	13,140
Schenectady	16,698	15,997	15,641	15,8[illegible]5	17,400
Schoharie	434	396	365	314	278
Schuyler	1,407	986	966	928	898
Seneca	3,460	3,890	4,500	6,567	10,762
Steuben	15,069	16,644	18,903	25,819	37,158
Suffolk	37,643	46,184	57,168	90,068	147,658
Sullivan	432	450	469	516	569
Tioga	2,591	2,628	2,853	3,414	4,129
Tompkins	4,867	5,443	5,873	6,850	8,005
Ulster	13,553	14,846	17,094	26,311	49,700
Warren	4,884	5,392	6,406	11,062	23,700
Washington	5,379	5,109	4,830	4,551	4,593
Wayne	6,246	5,990	5,977	6,104	6,384
Westchester	59,088	58,934	59,704	63,725	70,676
Wyoming	4,751	4,281	4,002	3,903	4,310
Yates	1,245	1,102	1,035	1,021	1,084
Totals	1,712,196	1,758,455	1,843,466	2,560,144	4,550,501

---

[1] Consultant's Analysis.

Table 6-4

Industrial Employment Density Projections for Counties[1] (Employees/Sq. Mi.)

County	Years				
	1965	1970	1975	1985	1995
Albany	49	50	55	77	125
Allegany	6	8	12	26	57
Bronx	1,251	1,104	1,014	925	909
Broome	44	53	76	188	507
Cattaraugus	7	8	11	22	53
Cayuga	13	20	31	84	263
Chautauqua	19	21	25	37	58
Chemung	36	42	51	87	162
Chenango	6	6	7	11	23
Clinton	3	3	4	21	123
Columbia	8	9	12	25	56
Cortland	11	12	13	17	23
Delaware	3	2	2	2	3
Dutchess	27	19	16	19	35
Erie	128	137	150	185	242
Essex	(0.60)	(0.46)	(0.44)	(0.65)	(1.44)
Franklin	1	1	1	2	3
Fulton	17	16	16	17	19
Genesee	15	18	28	110	754
Greene	5	5	5	7	11
Hamilton	(0.00)	(0.06)	(0.07)	(0.09)	(0.10)
Herkimer	8	10	13	27	59
Jefferson	6	8	11	25	70
Kings	2,999	2,789	2,669	2,640	2,865
Lewis	(1.35)	(0.93)	(0.81)	(0.67)	(0.57)
Livingston	6	7	9	17	35
Madison	2	2	4	13	50
Monroe	162	199	251	416	732
Montgomery	18	16	15	16	21
Nassau	294	306	332	449	747
New York	18,318	17,181	16,363	15,736	17,591
Niagara	64	74	82	108	156
Oneida	21	26	36	75	188
Onondaga	72	82	95	134	203
Ontario	6	10	13	30	89
Orange	20	22	25	39	70
Orleans	2	3	3	3	4
Oswego	8	8	9	12	18
Otsego	1	2	2	2	2
Putnam	5	4	4	3	2
Queens	1,109	1,047	1,005	973	1,002
Rensselaer	13	14	15	22	34
Richmond	161	177	183	208	254
Rockland	56	66	78	113	176
St. Lawrence	2	3	3	5	7
Saratoga	10	10	11	13	16
Schenectady	81	77	76	77	84
Schoharie	(0.70)	(0.64)	(0.58)	(0.50)	(0.45)
Schuyler	4	3	3	3	3
Seneca	10	12	13	19	32
Steuben	11	12	13	18	26
Suffolk	41	50	62	97	159
Sullivan	(0.44)	(0.46	(0.48)	(0.53)	(0.58)
Tioga	5	5	5	7	8
Tompkins	10	11	12	14	17
Ulster	12	13	15	23	44
Warren	6	6	7	12	27
Washington	6	6	6	5	5
Wayne	10	10	10	10	11
Westchester	133	133	135	144	160
Wyoming	8	7	7	7	7
Yates	4	3	3	3	3

---

[1] Consultant's Analysis.

Figure 6-1

Change in Industrial Employment and Agricultural Activity by Economic Areas[1]

Area No.	Economic Area	Type of Activity	Trend (Percent of State)	Industrial and Agricultural Activity Numbers[2,3]																								
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	Binghamton	Industrial	+	0	0	0	0	-	+	+	+	+	+	-	+	0	+	0	-	-	-	-	+	+	+	+	-	□
		Agricultural	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-										
2	Buffalo	Industrial	-	+	+	+	+	-	-	+	-	-	-	+	+	*	+	-	+	-	+	+	+	+	+	+	+	+
		Agricultural	+	-	-	-	-	-	-	+	-	-	-	-	+	+	+	-										
3	Capital	Industrial	-	-	+	0	0	+	-	-	+	+	-	+	+	-	+	0	+	0	+	+	+	-	-	+	-	-
		Agricultural	-	+	+	-	-	-	-	+	-	+	+	-	-	-	+	-										
4	Elmira	Industrial	+	0	0	0	0	+	0	-	0	+	+	+	*	0	+	0	0	0	*	+	+	+	+	+	0	0
		Agricultural	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-										
5	Mid-Hudson	Industrial	+	+	0	+	0	+	+	-	0	-	+	+	+	0	+	0	+	-	+	+	+	-	+	+	+	+
		Agricultural	-	-	+	-	+	-	*	-	-	+	+	-	+	-	+	-										
6	Mohawk Valley	Industrial	+	+	0	0	+	+	-	-	0	+	+	+	+	0	+	0	+	-	+	+	*	+	+	+	+	+
		Agricultural	-	+	-	-	-	-	*	+	-	-	-	-	-	-	-	-										
7	Nassau-Suffolk	Industrial	+	+	-	+	+	+	+	0	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
		Agricultural	-	+	-	+	-	-	-	+	-	+	+	-	-	-	-	-										
8	New York City	Industrial	-	-	+	-	-	-	+	-	+	+	+	-	-	+	-	*	+	+	+	+	*	*	-	-	-	+
		Agricultural	0	0	0	0	0	-	+	+	+	0	0	+	-	-	-	0										
9	Northern	Industrial	+	0	0	0	0	+	-	+	0	+	0	+	-	0	+	0	0	-	+	+	0	*	+	+	+	0
		Agricultural	-	0	+	-	-	+	-	-	+	+	+	-	+	-	-	-										
10	Rochester	Industrial	+	+	+	+	-	-	+	-	0	-	+	+	+	0	+	0	+	+	+	+	+	+	+	+	+	-
		Agricultural	-	-	-	-	+	-	-	-	+	-	-	-	+	-	+	-										
11	Syracuse	Industrial	+	+	0	0	-	+	-	+	+	+	+	+	+	+	-	0	+	+	+	+	+	-	+	+	+	+
		Agricultural	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
12	Westchester-Rockland	Industrial	-	0	0	0	-	-	-	-	0	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-
		Agricultural	0	-	+	-	+	-	-	-	-	+	-	-	-	-	-	-										

* Denotes that some activities in the Activity categories are increasing while others are decreasing.

[1] The State trend for agricultural activity is based upon Activity Numbers 7-15 only. Activity Numbers represent categories of several similar activities.

[2] Refer to Chapters 14 and 15, Tables 14-5 and 15-1 for correlation of Activity Numbers with SIC Code.

[3] Symbol (0) indicates no change (usually zero).

CHAPTER SEVEN

TRANSPORTATION

INTRODUCTION

The growth, development, and employment patterns discussed in Chapters Five and Six are intimately related to the transportation corridors and networks which have developed historically. Future inputs to the transportation system can reinforce or change past patterns, and the degree to which areas are served controls the amount and location of growth as well as the ease of movement of people and goods to other areas.

Since the principal concern of this study is a State-wide solid waste management plan, only those elements of transportation systems which appear to be most compatible with the economic transport of solid waste to ultimate disposal sites are considered. These include the highway network, railroad systems, and canals and waterways. Although airlines and pipelines can move materials rapidly over long and short distances, they appear to have no current feasible applications to the solid waste problem.

HISTORIC DEVELOPMENT

Canals were a tremendous stimulus for New York State's economic development. The Erie Canal, which opened in 1825, provided a sea-level route and reduced shipping costs across the Appalachians. Later, feeder canals tied much of the State to the Erie Canal. At its peak, the canal network extended into more than half of the State's counties.

Where the canals were unable to go, the railroads often could. The first railroads in New York State were begun in the 1830's, and at first supplemented the canals, whose routes they generally followed. Only later did the railroads become competitors of the canals. By 1870, the standard-gauge track had been adopted, and twenty years later many of the small lines had been consolidated into several large networks which encompassed the entire State. Because of the increased service, speed, and dependability offered by the railroads, canals lost passenger business, and although they retained their freight business, the volume did not increase. The tremendous growth in passenger and freight traffic between 1855 and 1915 was dominated by the railroads. Significant expansion of the canals ceased, and they began to shrink as some of the lesser-used links of the network were abandoned.

The turnpikes, which had flourished in the early part of the nineteenth century, fell into disrepair when the canals and railroads became the major transportation modes. Only toward the end of the century, when the automobile appeared, did roads begin to receive governmental attention. New York State created its Department of Highways in 1909 and began paving existing roads for year-round use. In 1916, the federal government made funds available for road construction, and in 1921 established a federal-aid primary road system intended to link major cities. In 1923, New York combined the Department of Highways with the Department of Public Works, which had been maintaining the canal system since 1878. In the 1920's and 1930's, efforts were made to pave all roads, urban and rural. By 1924, paved roads extended to all major communities in New York State, and by 1940, virtually all State roads were paved.

In the 1930's, roads serving considerable numbers of automobiles, trucks, and buses, began to become an increasingly important part of the overall transportation system. Today, trucks carry about one-fifth of the total ton-miles of freight in New York State. In the 1950's and 1960's, a major new network of expressways and parkways, stimulated by the federal Interstate Highway construction program, began to be superimposed over the network of two-lane and four-lane rural highways.

The importance that current and future transportation methods and systems have in regard to solid waste handling and disposal is obvious. The following discussion focuses on the nature, configuration, and capabilities of transportation systems as a factor in the development of the solid waste management plan.

SYSTEMS, METHODS, AND PRACTICES

In order to discuss in detail the existing and future networks and practices, each system (highway, rail, and waterways) is presented separately. The three systems are delineated on Map 7. Points of interface between systems and the implications on system and network development will be covered as the points occur in the presentation.

HIGHWAYS

STATE-WIDE NETWORK

Several major expressways link the urban area of New York State. The major north-south route in the eastern part of the State is Interstate 87, which is the New York Thruway from Albany south and the Adirondack Northway from Albany north to Canada. Interstate 81 is the major north-south route in the central section of the State; it links Binghamton with Syracuse and continues north to the Canadian border. Interstate 90, the New York Thruway, traverses the entire State from east to west, linking Albany, Utica, Syracuse, Rochester, and Buffalo.

The Southern Tier Expressway (Route 17) is another major east-west route. At present it links the Mid-Hudson area with Binghamton and Elmira. Proposed sections of this road will continue west through Jamestown, with a northern segment connecting Elmira with Rochester. Another proposed expressway (reconstructed Route 7) will link Binghamton with Albany.

Overall, the short-range highway plan provides for the construction of 350 miles of expressways, both inter-city and rural. The upstate urban areas of Rochester, Herkimer-Oneida, Niagara Frontier, Capital District, and Binghamton are part of planned transportation networks which will eventually link all cities with populations of 50,000 or more.

REGIONAL NETWORKS

The Westchester-Rockland Area is served by the New York Thruway (I-87) which passes through the two counties, connecting them at the Tappan Zee Bridge, which spans the Hudson River, between Tarrytown and Nyack. The east-west Cross-Westchester Expressway (I-287) links the New York-Buffalo Thruway with the New England Thruway (I-95). Supplementing the limited-access superhighways is a network of parkways and other key arteries, many of which are restricted to passenger car travel.

The Mid-Hudson Area is served by I-87 and the Route 17 expressway on the west side of the Hudson River, and by Route 22 and the Taconic State Parkway on the east side of the river. When completed, Interstate 84 will be the major east-west route in the southern part of the district. The Berkshire section of the Thruway (part of I-90 which connects with the Massachusetts Turnpike) crosses the northern part of the district.

The Capital Area is cut by the crossroads of major travel routes in the Northeast. Interstate 87 crosses Interstate 90 at Albany. Several short sections of expressway are proposed in the Albany Area to provide better access to the major highways.

The Northern Area, which is the least densely inhabited area in the state, is served by two major north-south expressways: I-87 in the east, and the North-South Expressway (I-81) to Syracuse and Binghamton, in the west. The 25-mile long St. Lawrence Scenic Highway, which follows the St. Lawrence River, was completed in 1967.

The "main street" of New York State, the Thruway, cuts through the Mohawk Valley district. Connections with the other expressways provide this area with direct access to Canada, Pennsylvania, New York City, and Buffalo.

The Binghamton Area is fast becoming known as the crossroads of the Southern Tier, as work progresses on two major highway-construction projects: the Southern Tier Route 17 Expressway, crossing the area in an east-west direction to connect Binghamton with New York City and the Great Lakes region, and the North-South Expressway (I-81), which ties the region to central New York, Canada, and Pennsylvania. In addition, the planned reconstruction of Route 7 between Binghamton and Albany will provide a direct, high-speed route to other important eastern cities.

Syracuse, the center of activity for the Syracuse Area, is the point of intersection for the east-west New York Thruway (I-90) and the North-South Expressway (I-81).

The Elmira Area's transportation network links it to Buffalo, New York, and other large cities throughout the State. The Southern Tier Route 17 Expressway, which is being developed into a major superhighway, traverses the area.

The Rochester Area is served by the Thruway (I-90), which crosses the area, and by I-490, which provides a loop access into the City of Rochester.

The Buffalo Area is connected with other major industrial centers of the State, the New York metropolitan area, Canada, and points west and south by the Thruway and by several other modern limited-access expressways. I-290 and I-190 form a loop around Buffalo and connect this city with Niagara Falls.

The New York City and Nassau-Suffolk Areas have many miles of expressways. The many bridges and tunnels provide access to outlying points in all directions. The Long Island Expressway is the main spine of access to Long Island (Nassau-Suffolk Counties); now under construction is an extension to this expressway which will provide better access to points east of Riverhead.

The importance of the highway network to a solid waste management plan is in providing the capacity for the large numbers of trucks required to move wastes from urban centers to disposal areas rapidly and efficiently. This is particularly true for large urban areas, where haul-time to a disposal facility or transfer station is critical to the economic success of an operation. The success is also a function of allowed load and size limits and speeds on major links of the network.

At the present time, virtually all solid waste generated in the State by the residential and municipal sector is moved by truck. They generally move short distances (less than 20 miles) to disposal sites, and when necessary and where feasible they use segments of the existing freeway and expressway systems. The vehicles generally in use have not as yet reached the weight and size limits set as maximum allowables on the interstate routes, State expressways, and State and local primary and secondary routes in New York. More to the point, waste hauling is carried out by a multiplicity of separate groups which have not yet melded together into operations large enough to demand "container system" hauling and handling so far as a truck-based vehicle over the highway network is concerned.

Manufacturers, on the other hand, in concert with the trucking, rail, and shipping industries, have developed an increasingly sophisticated goods-hauling system making use of containers, handling equipment, and vehicles. Trucking concerns have also introduced, and are constantly pressing for expanded right-of-way for tandem or double-and-triple trailer rigs over the interstate systems to gain the greater efficiency in haul cost resulting from delivery of two or three times the same payload on a one-cab trip.

At the present time, doubles or tandems are permitted only on the New York Thruway segment of the Interstate System. They must break to conventional rig when they leave the Thruway. Although federal agencies have given approval for tandems on all interstate links, the New York State Department of Transportation has not yet given its approval for any segment other than the Thruway.

In current practice, the largest conventional rig allowed on a State primary, expressway, or interstate route is 35 feet. The total length of a combination rig (tandem or semi-trailer) is 50 feet (55 feet on the Thruway). Total rig weight allowed on all highways except the Thruway is 65,000 pounds per trailed unit and 71,000 pounds per unit on the Thruway.

The important consideration for this report is use of the highway network with regard to movement of waste. On a broad scale, it is apparent that the State is well served by the regional and State networks with regard to inter-urban and exurban access. At a more local level (intra-urban and within a 15-mile radius of population centers) the picture with regard to access and road condition may not be so bright; a detailed investigation would be required to clarify the situation. It is in this 15-mile range that truck haul is an important element of waste handling, whether it be to an ultimate disposal site or to transfer station for conveyance by another mode. Modern materials-handling systems may be an important consideration; for instance, if the "packer unit" were removable from the truck bed, a tractor could trade a full unit for an empty one, thus cutting vehicle time for collection.

RAILROADS

STATE-WIDE NETWORK

Railroads provide the means for a large-scale movement of bulk materials at relatively good speeds and at generally lower rates than a long truck-haul operation. This makes them well suited for transporting large amounts of solid wastes over long distances between major collection points and disposal facilities. As yet, this mode has not been used despite recognition of its technical feasibility.

The State is provided with an extensive network of rail lines. The present system, shown on Map 7, provides freight service to every community of 10,000 or more population. As would be expected, those areas with little or no population are not served, even by feeder lines, and the major main lines run up and across the principal development corridors of the State. In the process of growth, many separate companies built parallel lines in a number of sections of the State. As business on branches declined, the railroads, as part of an efficiency plan and upgrading of service standards, have gradually been reducing duplicate and uneconomical trackage, particularly on branch lines. Mergers have also led to abandonments as trackage of two competing railroads was consolidated into one rail line.

The Department of Transportation plans to intensify industrial and other growth centers and corridors and link them by an intensive rail-freight network with a series of feeder lines. Lines are proposed to link the southern tier rail-freight centers with the Mid-Hudson Region (Middletown). Another north-south line is proposed to link the Binghamton area with Syracuse and the St. Lawrence Seaway. These proposed new links, in conjunction with improvement of existing rights-of-way, would provide the State with intensive rail-freight service through the major corridors and the connecting valleys and would connect these areas in a complete-interval system. This would permit large-scale bulk shipping from any population center, via feeder lines, to any other location. The implications of this proposed system to solid waste handling would be to allow efficient mass shipment of wastes via special spurs to centralized large-scale disposal operations on a more economic basis than is now possible. It also implies an increasing sophistication in rail vehicles and their capabilities, which would benefit a waste-hauling system.

RAIL-HAUL METHODS AND PRACTICES

The railroads operate under federal regulations insofar as passenger and freight rates and materials are concerned. This is purportedly to maintain equal competitive advantage between rail, truck, and water-haul operations. The Interstate Commerce Commission sets rate schedules and reviews any requested changes, and no State agency has been delegated (by the Federal Government) to set rates or to affect them. Therefore, costs of using rail haul are not subject to State control. The cost to a region which might use rail haul for solid waste transport could be reduced through a State-sponsored subsidy program, but all information indicates that this not likely to happen.

In contrast to the many regulations governing vehicles on State highways, there are no State or federal rules and regulations governing length of cars, axle loads, or other related items. The railroads have come up with their own regulations based on the loads their tracks will carry. The biggest free-running car (one that can go on any main line in the country without previous special interline arrangements) is allowed a maximum of 65,750 pounds per axle, a height of 15'1" from the track to the top of the car, a width of 10'8", and a length of 41'3" between axles. Longer cars are in operation over restricted trackages or with special interline arrangement; the longest car in use is 136 feet.

The railroads have completed some (and are forecasting even more) technical innovations in equipment and control to increase the capacity of the system. Among these have been the introduction of special-purpose cars, automatic car identification, and a computerized car-location system. Piggy-back operations - the use of container-on-flatcar (COFC) and truck-on-flatcar (TOFC) - increasingly account for an important share of rail freight movements. Piggy-back and container operations also increase intermodal efficiency, because transfers to trucks, ships, or barges are handled more quickly. Although container handling is efficient and rapid, there is evidence to suggest that waste handling, unless the waste is specially treated and packaged in COFC disposal units, is most economical in deep ore-bin or hopper cars.[1]

---

[1] From a Reading Railroad Report of a solid waste rail-haul study in the Philadelphia metropolitan area.

New marketing techniques have also been adopted. Among these are the rent-a-train, used to date only for grain shipments, with the shipper charged an annual "rental" and a low charge per ton mile. With regard to spur extension, which in most cases would be required for regional rail haul directly to large "disposal parks", most railroads require the estimated cost to be advanced before construction is begun by the railroad, with subsequent funds or additional payments to adjust estimated cost to real cost. Then, generally for the following five years, the railroad refunds to the client the deposit paid on the basis of number of cars and road haul revenue per car using the spur. Although it is anticipated that the revenue per car on waste material may be low, such revenue would reduce the cost of spur extension to some extent.

CANALS AND WATERWAYS

STATE-WIDE NETWORK

New York State is served by two segments of water-borne transport: the Hudson River and Great Lakes essentially at the perimeter and the New York Barge Canal in the interior. Together they provide a southern access for continuous water transport from the Atlantic Ocean up the Hudson River to the canal junction at Waterford and then either north to Lake Champlain or west to Lake Ontario or Lake Erie. From these points ships or barges can move out to the Atlantic Ocean or to other Great Lakes ports.

Of New York State's ports, eight have a depth of at least 22 feet and handle more than 250,000 tons of freight annually. These are the Ports of: New York and Albany on the Hudson River; Buffalo, on Lake Erie; Rochester, Sodus Bay, and Oswego on Lake Ontario; Ogdensburg, on the St. Lawrence River; and Port Jefferson, on Long Island Sound. A new port has been proposed near Kingston on the Hudson River, and expansion of existing ports has also been recommended to meet anticipated growth in water shipping.

The total New York State Barge Canal, some 524 miles in length, is composed of four divisions. In the east, connecting with the Hudson River at the Waterford Locks maintained by the Corps of Engineers, the Champlain Division is 60 miles long and provides access to Lake Champlain and the northeast. The Erie Division connecting with the Hudson River near Waterford, extends westward some 348 miles, connects with the Tonawanda River, and provides transport to Buffalo's port and into Lake Erie. Two other divisions tie into the Barge Canal near the midpoint of the Erie Division. The Oswego Division, 24 miles long, provides access from the Erie Division to the port in Oswego and into Lake Ontario. The Cayuga-Seneca

Division, 92 miles in length, provides access from the Erie Division into Seneca and Cayuga Lakes and the City of Ithaca. Very little tonnage has been moved across this last division in recent years in comparison to the other three divisions.

No major expansion or improvements to the Barge Canal are currently proposed. However, the Federal Government is studying all facets of canal use and operation to determine the extent of modernization required to permit its use by modern float equipment. The U. S. Corps of Engineers is also conducting a study and evaluation of the feasibility and justification for a new canal in western New York State. Called the All-American Canal, it would connect Lake Ontario and Lake Erie across Niagara and Erie Counties. This canal, if effectuated, would cut travel distance and time between the two lakes.

WATER-HAUL METHODS AND PRACTICES

An important consideration in the increased future usefulness of the waterways, ports, and canals for general freight movement, is the availability of satisfactory facilities to transfer materials to land-based transport modes. The applicability of water-haul (particularly barging) transportation of solid waste has already been proven to a certain extent by the increased use of barges to dispose of sewage sludges, certain industrial waste liquids and sludges, and building materials in the Atlantic Ocean. Only non-floatable wastes may be disposed of in this manner. Today, there are six dumping grounds designated in the Atlantic Ocean off the entrance to New York Harbor, each for a particular type of waste, as follows: Mud (dredgings), Cellar Dirt (excavation and foundation material), Sewage Sludge (raw and treated), Wrecks, Waste Acid, and Waste Chemicals. The entire procedure, which involves issuance of dumping permits, is supervised by the Corps of Engineers. Disposal of solid waste at sea may be feasible if the wastes comply with requirements, e.g. must be not floatable. Studies are currently underway by the Corps of Engineers, the Woods Hole Oceanographic Institute, and others to determine the effects of this disposal method.

Special loading facilities are operated by the various municipalities, industries, and private interests using waste barging in this manner. The haul distance involved appears to be a significant factor in determining whether this particular disposal method is economically feasible. The economics are further affected by size of float and load transported.

There are no specific restrictions on the movement of wastes by barge on the State's waterways (Hudson River, Lake Champlain, Lake Erie, and Lake Ontario). In fact, large bulky wastes such as scrap metal, wrecked autos, and similar materials are handled in that manner now. The Corps of Engineers maintains the channels on these waterways, coordinates and cooperates in port and transfer operation development, and would control the use of any waterway areas for dumping or filling. At the present time, all of New York State's ports function separately and independently of each other. Coordination of port activites by the Corps of Engineers, the Port Authorities, and the Department of Transportation would permit specialization based on the locational advantages of each port for different products, materials, and shipping patterns. This could include development of special ports and facilities to handle the transfer and loading of appropriate wastes (sludges, industrial liquids, large bulky wastes) for haul to appropriate disposal sites or dumping grounds.

The feasibility of moving wastes across the Barge Canal System is subject to certain constraints. Operated by the State, the Barge Canal is controlled by the Waterways Division of DOT, which is responsible for dredging, lock and bridge maintenance, and coordination of port and loading facilities development along the banks. Terminals are provided for the receipt and discharge of canal freight at the principal points of shipment. Any loading, unloading, or storage operation development at points other than these terminals requires a permit.

Restrictions regarding size of float are a function of lock size and bridge clearance. The canal from Waterford to the Oswego branch leading into Lake Ontario can take a maximum draft of 12 feet, with a maximum height of load and float above waterway of 19-1/2 feet. On the remaining reach of the Erie Division and on the three other Divisions of the canal system the maximum draft allowed for any barge or float is 10 feet, and the maximum allowable height of load plus float above the water line is 15 feet. The largest size float (float is defined as a barge by itself or a barge with tug) that can be accommodated is 43-1/2 feet in width by 300 feet in length. The most common units or combinations operating in the canal are: a) 260-foot barge with tug making up the allowed 300-foot floating apparatus; b) 300-foot long barge pushed by tug, which requires two lockings to get the entire combination through a lock; c) a self-powered 300-foot long barge; and d) a 300-foot long barge pushed by a second 240-250 foot barge and tug, making two 300-foot floating units, which also requires two lockings to get the entire assembly through. Without special permission of the superintendent, no fleet can consist of more units than may be passed through a lock in two lockings. Finally, in the canal channels, floats are restricted to a speed of six miles per hour except in canalized rivers and lakes, where the speed limit depends upon traffic conditions.

Several issues face DOT with regard to continued use of the Barge Canal. The first is the question of modernization to permit use by modern float equipment. This would involve widening locks and channels to permit larger, deeper-draft floats. There is also the question of transfer of the Barge Canal to the Federal Government. The legislature was authorized to do this by referendum in 1959. The alternatives are: continued operation and possible improvement of the canal by the State, which might require user charges; or no improvement and possible contraction of the Barge Canal Network.

ULTIMATE SYSTEM CAPABILITIES AND LIMITATIONS

The real question, in the final analysis, is the effective usefulness of these major transportation systems in the handling of waste materials. It would appear that this is a function both of the size of the originating population complex and of the scale of operation.

For small population centers in sparsely settled areas (under 10,000 persons) use of the current "packer truck" or variations, with road hauls of up to 20 miles to a suitable facility, continues to be the most effective waste transport medium. However, for areas of major population concentrations where the volume of waste materials is large, an area- or a region-wide disposal system is employed; then a "zone of effectiveness" comes into play, and the particular characteristics of each transportation system and of the waste being moved become important. In such a situation, where sites are beyond a 15-20 mile distance from the population center, a truck-haul operation to a transfer station may be the best solution for household, commercial, and most municipal wastes. It has been established in New York Department of Health and other studies that beyond 15 miles, a truck operation is uneconomical when large volumes of wastes must be moved. The possibility of containerized packers to allow faster turnaround and handling at such a station, while maintaining a cleaner operation, is only one of several practical methods for handling household and commercial wastes. If feasible and eventually allowed, "trains" of three packers in tandem could extend the radius of economic service for transfer station operations.

At this point, the use of the two remaining modes is a function of type of waste and location of facility. Consider first certain special problem industrial wastes, such as bulky wastes, or dredgings and sludges. If the transfer station or waste source is near the water, then barging to appropriate dumping sites or final treatment facilities is feasible. In these circumstances the low value of waste, the need for special centralized disposal, and/or the special nature or possible danger of contamination of waste disposed in the normal manner generally make barging the preferred solution if carried out on the major state waterways. The Canal Barge is limited in this regard, because weather forces a closing from November 15-30 to April 5-20, and the size of float is restricted.

The final and most promising mode for large-area, large-volume waste movement is rail haul. With innovations and improvements in types of cars, car handling, terminal handling, and transfer facilities, the railroads can accept materials in virtually any form and move them over long distances, at relatively low cost, and at good speeds. Speed is significant only as a health problem, not as an economic one. The only limitations on this system would be the difficulty of encouraging the needed spur construction (owing to low ton-mile value of waste) and integration of spur construction with on-loading facilities at transfer stations and off-loading facilities at ultimate disposal sites.

The success of any method that may be adopted depends upon appropriate distance and operation cut-off points with regard to these transportation systems. The detailed solutions of loading operations, intermodal transfer, and handling operations require further investigation concerning relative costs. For example, rail haul is more economic if fully a point-to-point operation. Charges for handling "containers" or "vehicles" in a transfer can cost as much as 100 ton-miles of material-haul, based on 1968 Penn Central rate schedules. These factors and the many other discussed in preceding and succeeding chapters, all have a bearing on the choice of the most effective mode or combinations of modes and transfer facilities.

CHAPTER EIGHT

PHYSICAL AND NATURAL CONDITIONS

INTRODUCTION

In selecting a site for solid waste disposal the following physical and natural conditions must be taken into consideration: geology - including soils and bedrock; topography; hydrology - including surface- and ground-water drainage and potential pollution; and meteorology - including climate, prevailing wind directions, and potential air pollution. Evaluation of these environmental factors is particularly important in the selection of a proper site for a sanitary landfill. Some of these factors are also important in the site location of an incinerator, and specific incinerator considerations will be discussed whenever they are applicable.

GEOLOGICAL FACTORS

1. The soil permeability at a landfill site should be such that the movement of refuse leachate will be retarded sufficiently to permit purification of water by bio-filtration through the subsoil. Sites where coarse sand gravel occur are generally unsuitable for refuse disposal because of their high permeability and their consequent use or potential use as aquifers for water supply.

2. The ideal soil at a landfill site should be workable and compactable. Such a soil is commonly a sandy loam or a sandy clay-silt.

3. A coarse soil such as sand or gravel at a landfill site may require a greater depth of cover to prevent rodent infestation.

4. A large amount of stones or boulders in the soil of a landfill site interferes with excavation, obtaining suitable cover material, establishing grade, and laying out tile drainage, if needed. Where stones and

boulders are many, they are hazardous to foot and vehicular traffic. Also, the highly variable nature of stony soils generally allows rapid transmission of leachate to the water table.

5. A soil containing large quantities of clay may present an operational problem during wet weather, and, under certain conditions, it may tend to shrink and crack. Soils of this type may also present an excavation problem during cold weather.

6. Depth to bedrock or thickness of the soil cover can severely limit the use of the land for sanitary landfill. Shallow bedrock limits the depth of the landfill excavation. A basic essential of sanitary landfill is the use of sufficient earth cover during and after completion of the fill. Thin soils may be inadequate for obtaining this covering fill. Also, thin soils may not provide enough filtration/adsorption capacity for leachate; where bedrock is close to the surface, seepage and pollution problems may result as the subsurface water, carrying leachate, moves along in contact with bedrock until it seeps out at the surface or into a potable aquifer.

7. The type of bedrock underlying the landfill must be considered, especially in areas of thin soil. Water-bearing formations must not be contaminated by leachate. For example, a cavernous limestone aquifer would make a landfill site unsuitable in the soil above.

TOPOGRAPHICAL FACTORS

1. The selected landfill site must be large enough to contain the projected refuse volumes. The size of the depression, ravine, lowland, or other acceptable site largely determines the amount of fill that can be placed in the area.

2. The topography of the prospective landfill or incinerator site should be considered as to its accessibility by trucks and other vehicles throughout the year.

3. Ultimate elevation and drainage of the completed fill as well as the effect of changes in elevation of the completed fill on adjacent property must be considered.

4. The choice of operational method to be used in a landfill depends upon the topography of the site, e.g. area method, trench method, etc.

5. The topography of selected landfill sites should be such that surface runoff into or through the site can be controlled.

HYDROLOGICAL FACTORS

1. Distance from landfills to streams, lakes, or other bodies of water must be evaluated to prevent surface-water pollution through surface or subsurface drainage.

2. Horizontal distance from wells and springs, horizontal and vertical distance from aquifers, and the characteristics of the intervening subsoil or rock must be considered to prevent ground-water pollution at a landfill site.

3. The elevation of the seasonal high water table is an important factor; it should be as deep below the base of the fill as possible to prevent ground-water pollution. Refuse deposited below the water table or in standing water should not be permitted.

4. Natural surface runoff must be considered in site location for a landfill. Provisions must be made for drainage of the site as the landfill operation progresses and after it is completed.

5. Flooding conditions that can erode the cover material, expose the refuse, and cause the rapid travel of pollutants through the refuse to the ground-water table must be avoided.

METEOROLOGICAL FACTORS

1. In cold weather, problems that may be involved in operating a landfill include the difficulty of trenching in frozen ground, moving stockpiled cover material when pre-trenching is practiced, and consolidating large pieces of frozen soil in the final cover.

2. In prolonged wet weather, problems involved in operating a landfill may include: a soil too soft to support equipment or too mushy to trench readily or to consolidate the final cover; and trenches full of water. Also, increased rainfall is often accompanied by increased seepage, and more leachate may be produced. Specific provisions for wet weather operations must be considered.

3. The wind (speed and direction) is an important consideration. The wind may stir up dust from the general area of operations and may cause a little problem that could spread beyond the confines of the landfill site. Knowledge of the direction of prevailing winds will permit planning for location of fences to control litter and also indicate layout and direction of refuse placement. Prevailing winds must be considered in selection of an incinerator site; even if proper air pollution and odor

control techniques are used, the location of populated areas with respect to the incinerator site must be evaluated.

OUTLINE OF PHYSICAL AND NATURAL CONDITIONS IN NEW YORK STATE

The climate of New York State may be generally characterized as humid and temperate. However, there is considerable variation due to location and topography. The mountain and plateau regions, for example, have heavy snowfalls and wide changes in temperatures; whereas Long Island, under the moderating effect of the ocean, has light snowfall and fairly constant temperatures. The lowland areas adjoining the Great Lakes have a milder climate than the nearby uplands. Average annual precipitation ranges from about 28 inches near Lake Champlain to over 60 inches in the Catskill Mountains (Figure 8-1). Average annual snowfall ranges from 27.1 inches in New York City to 88.1 inches in Oswego. Average annual runoff ranges from over 40 inches in the Catskills and in the Tug Hill Upland to less than 10 inches in the Champlain Valley and in the region south of Rochester (Figure 8-1).

In the eastern part of the State, average annual temperatures range from 40.3° at Lake Placid to 54.7° at La Guardia Airport. Extremes ranging from 50°F below zero in the Adirondacks to 105°F at other stations have been reported.

The climate of the central and western parts of the State is influenced by proximity to the Great Lakes. Temperature extremes are moderated by the lakes, and snowfall near the lakes is about 50 percent greater as a result of lake-borne squalls.

PHYSIOGRAPHIC PROVINCES

Almost all of New York State underwent glaciation during the Pleistocene Epoch, and glacial deposits overlie the bedrock in depths ranging from 0 to about 2,000 feet. However, the subdivision of the state into major physiographic provinces is based mainly on the varying ways in which the underlying bedrock, of different lithologies and structure, has reacted to erosional forces over the past 65 million years. The following brief descriptions of the nine physiographic provines shown in Figure 8-2 are based on the text of the 1962 Geologic Map of New York State. The soil descriptions are taken from Cline (9).

ST. LAWRENCE-CHAMPLAIN LOWLANDS

This province is underlain by Cambrian and Ordovician sandstones, dolomites, and limestones, which dip gently away from the Adirondacks. Relief is approximately 100 feet. Streams draining the northern and eastern

Adirondack slopes dissect the province, and much of the Lake Champlain shoreline is dominated by North-South and East-West faults.

In the Champlain Lowland, (eastern Clinton County), where the Nellis-Amenia soil association is dominant, the nearly level to sloping areas are underlain by well- and moderately well-drained soils developed on highly calcareous glacial till. The dominant soils have good structure, but a high proportion are shallow relative to the bedrock.

In the St. Lawrence Lowland, the Nellis-Swanton soil association underlies a large area in St. Lawrence County. In areas of this association, low ridges of well-drained calcareous glacial till derived from limestone are interspersed with low-lying flat land of poorly-drained sand over clay. Rockland soils cover a large area in St. Lawrence County, and are also found in northeastern Jefferson County. In this area more than 50 percent of the land is bare bedrock. The intervening soils are generally shallow, and include soils from clay, glacial till, and sands. Locally, where rock surfaces are nearly level, a thin uniform cover of soil material covers the rock.

ADIRONDACK HIGHLANDS

The highest mountains in New York State are located in this province, which is underlain mainly by highly resistant anorthosite. The average relief in the province is 2,000 feet. The average elevation decreases gradually from the High Peaks area except where the slope is more abrupt eastward to the Champlain Lowland. The Adirondacks are transected by long northeast-southwest lineaments, representing shear zones or major faults, which often control the drainage and topography. Glacial deposits have clogged the normal drainage, and the lower areas have many lakes, ponds, and swamps.

The Adirondacks are mantled by very stony soils developed on glacial till. The Herman-Becket-Rockland association represents the major part of the Adirondack Highlands.

TUG HILL UPLAND

The Tug Hill Upland is an isolated area lying between the eastern part of the Erie-Ontario Lowlands and the Black River Valley of the same province. It has an elevation of 1,800-2,000 feet and low relief. The Tug Hill Upland is supported by a cap rock of Ordovician Oswego Sandstone, which overlies a thick series of sandy shales and older limestones. The low slope of the cap rock and the thin cover of glacial deposits have resulted in poor drainage and many swamps in the province.

The Tug Hill Upland is underlain by the Worth-Empeyville-Westburg association. This area is dominated by very stony, acid soils developed on glacial till with a strong fragipan horizon.

A very high proportion of the acid soils developed in glacial till in the State possesses a subsoil horizon that is very tightly packed and slowly permeable to water, called the fragipan. The horizon has resulted in the development of very large acreages of poorly-drained soil throughout the acid soil regions. It retards downward movement of water, causing seepage down hill, and relatively poor drainage even on strongly sloping areas. A high proportion of the potential drainage problems of the State are related to this condition.

ERIE-ONTARIO LOWLANDS

This physiographic province, which includes the cities of Rochester, Buffalo, Niagara Falls, and Syracuse, encompasses the relatively low and flat areas which border Lake Erie and Lake Ontario and extend up the Black River Valley. The land rises gently eastward and southward from the lake levels of 570 and 244 feet, respectively, to about 1,000-1,500 feet along the boundary with the Appalachian Uplands. In the Ontario Lowlands, east-west trending escarpments are formed by the Silurian Lockport Dolomite (the cap rock of Niagara Falls and the falls of the Genesee River at Rochester), and by the Devonian Onondaga Limestone. It should also be mentioned here that carbonate rocks are the most productive bedrock in the State with regard to ground water. Glacial deposition has left drumlin fields, recessional moraines, and shoreline deposits, which modify the topography.

The Fulton-Toledo soil association is common near Lake Erie. In areas of this association, wetness and fine texture severely limit the use of the nearly level areas of lake-deposited clays and silts. Drainage is the predominant problem. Also, the Aurora-Angola association is widespread in this part of the province. These soils, although shallow over shale bedrock, are moderately well- to poorly-drained.

On the south shore of Lake Ontario, the Collamer-Dunkirk and the Sodus-Ira soil associations predominate. The Collamer-Dunkirk association is developed on nearly level to gently rolling areas of calcareous lake-deposited silts. These areas are dominated by soil with medium textures and moderately restricted internal drainage. The soils of the Sodus-Ira association are on undulating to rolling topography, where the till contains a high percentage of limy sandstone clasts. The dominant soils have moderate to strongly expressed fragipans 18-30 inches below the surface. Stoniness is a major problem throughout much of the area of this association.

The drumlin field between Rochester and Syracuse is within the Ontario soil association. The drumlins are deposits of calcareous glacial till. These are deep, well- and moderately well-drained undulating to sloping soils. Locally, between the drumlins, soils from glacial outwash or from lake clays are important.

In the Black River Valley, the Camroden-March soil association is developed on the broad, smoothly-sloping, till-covered hills. This soil is described under the Mohawk Valley Province. The Colton and Adams soil association also covers a large area of the Black River Valley and is made up of well to excessively-drained soils developed on sand and gravel.

HUDSON-MOHAWK LOWLANDS

The topography of this lowland has been developed by erosion of weak-rock outcrop belts. Much of the area has low elevation and relief, and is underlain by Ordovician shales. The province includes the Schenectady, Troy, Albany, and Utica-Rome areas.

The Troy-Cossayuna soils are the dominant association on the undulating to rolling glacial till plain of the Hudson Valley. These soils are dominantly deep, well- or moderately well-drained, and only moderately stony, although the fragipan causes drainage problems in some areas. Also prevalent in the Hudson Valley is the Rhinebeck-Madalin association, which is developed on nearly level to strongly sloping areas of calcareous lacustrine silts and clays. They have a soil-loam surface texture, but silty-clay subsoils. The soils range from well- to poorly-drained. Bordering the New England Upland in Dutchess and Columbia Counties are the Nassau, Macomber, and Manlius associations dominated by shallow or very shallow soils with 10 to 25 percent of the area in bedrock outcrop.

The Camroden-March association is developed on the broad, smoothly sloping hills of the Mohawk Valley. The slopes are covered with till which contains a high percentage of local dark-colored shales. The soil has a medium-textured upper portion over a more clayey fragipan 15 or 20 inches below. Improvement of drainage is difficult because of the fragipan. The Mohawk Valley also possesses the Poland Turin and Mohawk-Manheim associations. On these dominant gently-sloping or undulating areas are dark-colored glacial till soils, high in dark shale. These soils lack fragipans and are dominantly deep and well- to moderately well-drained.

APPALACHIAN UPLANDS

This province, which stretches from the Catskills in the east to southern Chautauqua County in the west, includes the metropolitan areas of Jamestown, Elmira, Ithaca, and Binghamton. The plateau is formed by the dissection of uplifted, gently dipping Devonian rocks. Relief is high to moderate. Drainage is generally southwest into the Allegheny, Susquehanna, and Delaware River systems, except for Cattaraugus Creek, the Genesee River, the Finger Lakes, and minor streams along the Catskill front. The Finger Lake Troughs represent glacially modified valleys of pre-glacial rivers, and Cayuga and Seneca Lakes have bedrock floors below sea level.

Glaciation has left thick deposits in the North-South valleys, completely burying some. On the Uplands the glacial cover is usually thin, and the Allegany State Park area in Cattaraugus County contains no glacial deposits.

The most common soil associations in the Appalachian Plateau are the Lordstown-Volusia and Lordstown associations. In the Lordstown-Volusia areas, the valley floor is normally underlain by glacial outwash, and deep glacial till occupies a uniformly sloping area that extends from 1/8 to 1/2 mile from the valley floor. The Lordstown association is dominated by steep shallow soils.

In the eastern part of the plateau in the Catskill Mountains, which is underlain by red sandstone and shale, the Oquaga-Lackawanna association is dominant. These soils are generally medium-textured and contain fragipans. On the steep slopes are the shallow Oquaga soils which occupy from 30 to 50 percent of the area. The well-drained, deep Lackawanna soils are on the steep and strongly sloping hillsides, where the glacial till mantle is deepest.

Two soil associations prevalent in the western part of the plateau are the Volusia-Mardin and the Erie-Langford associations. The Volusia-Mardin soil area is one of the major soil problem areas of southwestern New York. The area presents a landscape of broad, till-covered hills whose long, uniform slopes are predominantly poorly drained. The dominant soils have strongly expressed fragipans at 12 to 18 inches below the surface. Drainage is the problem; the soils are slow to dry in the spring and "seep spots" are common. The Erie-Langford association occupies broad, smoothly sloping, till-mantled hills. Water tends to accumulate above a slowly permeable fragipan horizon in the dominant soils on these long slopes, and makes the most important soils poorly drained.

NEW ENGLAND UPLANDS

This province encompasses Manhattan, the Bronx, and part of Staten Island, Westchester County, the Taconic Mountains area, and the Hudson Highlands. The rocks in this province are either metamorphic or igneous, and the topography shows a close relationship to the relative resistance to erosion of the formations. The Rensselaer Plateau, located east of Troy is a rolling plateau surface with relief of more than 500 feet. This 180 square-mile area is held up by the resistant Rensselaer Graywacke.

In the New England Upland, the dominant soils are the Rockland and the Pittsfield, Wassaic, and Stockbridge associations. The Rockland soil, which predominates in the Hudson Highlands, is very shallow and interspersed with bedrock outcrops. The Pittsfield, Wassaic, and Stockbridge areas are mainly steep-sided valleys in which dominantly well-drained soils have developed on glacial till. In the Rensselaer Plateau, the gently sloping to hilly areas, dominated by glacial till, have very stony soil known as the Worth-Empeyville-Westbury association.

THE TRIASSIC LOWLAND

This province, which is found both in Rockland County and in Staten Island, is underlain by Triassic "redbeds" (sandstones and shales) and igneous trap rocks. A prominent feature of the province is the Palisades, a north-south escarpment developed on the diabase "sill" which forms the west bank of the Hudson River from Nyack to Staten Island. The Triassic Lowland redbed areas are mantled by deep glacial till in the valleys and shallow soils on the upper slopes of the hills. The soils in this area, (the Rockaway-Chatfield association) are generally stony. The Basalt areas are mantled by the steep Rockland association where soil is shallow and outcrop is plentiful.

ATLANTIC COASTAL LOWLAND

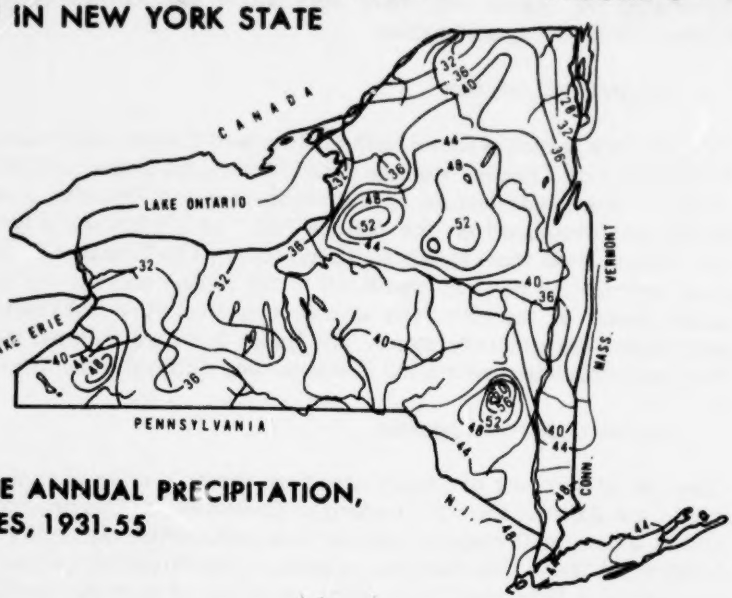
Long Island and part of Staten Island are the only areas of New York State within the Atlantic Coastal Lowland or Coastal Plain. This province is underlain by a core of Cretaceous sedimentary rocks which dip gently toward the Continental Shelf. The terminal moraine of the Wisconsin glacier crosses the province in a hilly area from which an apron of outwash detritus extends seaward. The outwash plain of Long Island is dominated by coarse-textured soils developed on sands and gravels. The soils, of the Colton and Adams Association, are dominantly well- to excessively-drained. A coarse, sandy soil developed on glacial till is found in the moraine area to the north. These soils, in the Plymouth-Haven association are excessively drained.

SUMMARY

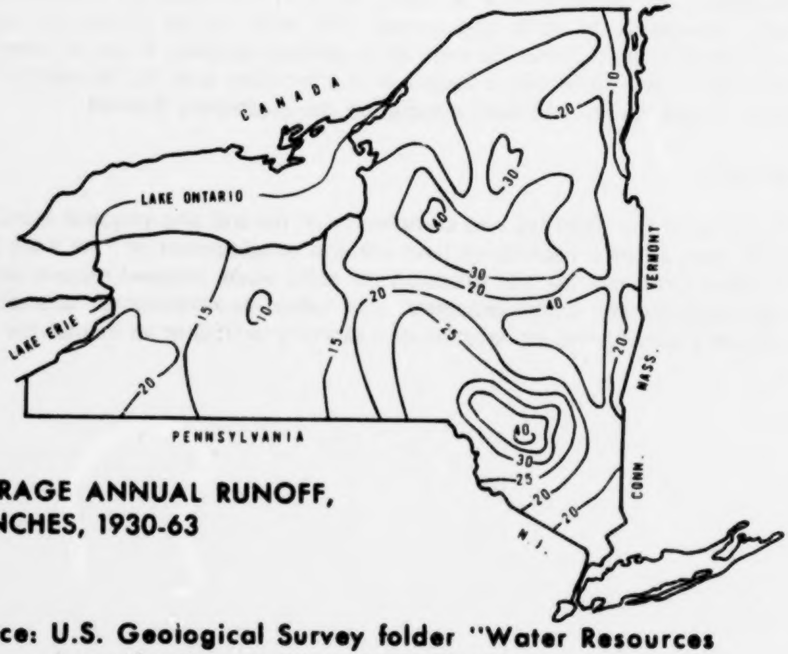
Because of the diversity and complexity of natural and physical conditions that have a direct bearing on land use and development in New York State, modern practices for site selection for solid waste disposal require detailed investigation by hydrogeologists and other environmental scientists to properly select a site for location of a sanitary landfill or an incinerator.

DISTRIBUTION OF PRECIPITATION AND RUNOFF IN NEW YORK STATE

FIGURE 8 - 1


CANADA
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
VERMONT
MASS.
CONN.
N.J.
32
36
40
44
48
52
36
40
44
48
52
32
36
40
48
36
40
36
40
48
52
40
44
44
48
48
44

AVERAGE ANNUAL PRECIPITATION, IN INCHES, 1931-55

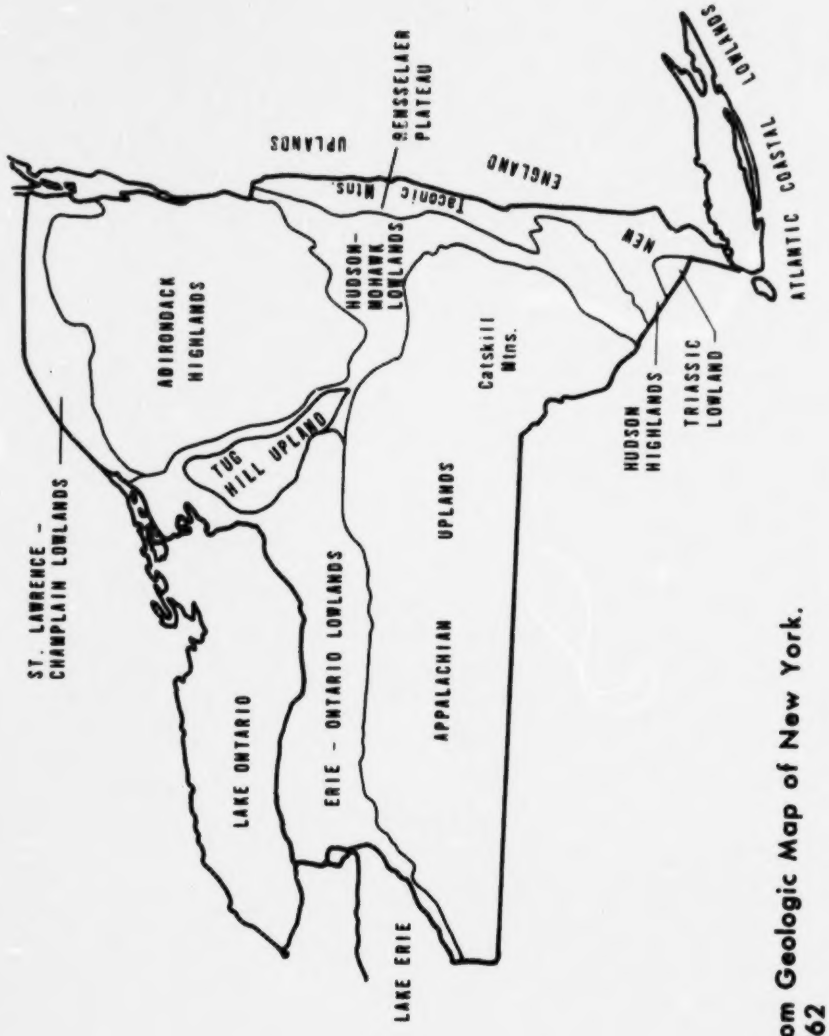

CANADA
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
VERMONT
MASS.
CONN.
N.J.
10
20
30
40
30
20
20
40
25
15
10
15
20
20
40
30
25
20
20

AVERAGE ANNUAL RUNOFF, IN INCHES, 1930-63

Source: U.S. Geological Survey folder "Water Resources Investigations in New York State."
Date: (1965)

PHYSIOGRAPHIC PROVINCES OF NEW YORK STATE

FIGURE 8 - 2


ST. LAWRENCE - CHAMPLAIN LOWLANDS
ADIRONDACK HIGHLANDS
TUG HILL UPLAND
HUDSON-MOHAWK LOWLANDS
RENSSELAER PLATEAU
Taconic Mtns.
NEW ENGLAND UPLANDS
Catskill Mtns.
HUDSON HIGHLANDS
TRIASSIC LOWLAND
ATLANTIC COASTAL LOWLANDS
LAKE ONTARIO
ERIE - ONTARIO LOWLANDS
APPALACHIAN UPLANDS
LAKE ERIE

Source: From Geologic Map of New York.
Date: 1962

CHAPTER NINE

STATE AGENCIES AND LEGISLATION

INTRODUCTION

Potentially, the most critical elements in the effectiveness and success of any State-wide solid waste plan are the legislation and actions by designated agencies which provide the framework and the power by which a plan is carried out. To date, most of the applicable New York State legislation allows action, but does not require it, and delegations of authority or responsibility are not entirely clear in a number of areas. This chapter presents a discussion of the current legislation, agencies, responsibilities and enforcement, and control aspects of solid waste management, planning, and implementation in New York State. It is from these bases that future actions and recommendations for change and improvement must be made.

EXISTING LEGISLATION AND LAWS

There is a significant amount of State legislation which has current or potential impact on solid waste management and disposal. Much of the legislation is very clear and provides explicit direction, while other laws and regulations overlap, making interpretation and direct effectuation difficult.

Three pieces of legislative action have had a major impact on solid waste management and control in New York. The first was the adoption of Part 19 of the State Sanitary Code, "Refuse Disposal," which became effective 1 January 1963. Its basic sections deal with disposal sites, incinerators, and enforcement. In substance, the Code: 1) requires all refuse disposal sites, both private and municipal, to be operated as sanitary landfills; 2) includes regulations prohibiting the burning of refuse at such sites, 3) discourages scavenging; 4) specifies fill requirements for face and compaction, and for cover, vector and litter control; and 5) requires approval of new sites and proposed operation by health authorities. The Code also prohibits the disposal of solid waste material in any manner or in any location which would result in a violation of the Public Health law against water pollution. With regard to incinerators, the Code requires that municipal as well as private incinerators be operated and maintained so as not to create a nuisance or hazard to public health. (Regulations of the State Air Pollution Control Board provide that plans for new incinerators must be submitted to the Air Pollution Control Section of the State Department of Health for approval prior to construction.) Finally, the Code specifies and delegates regulatory control as the responsibility primarily of full-time city and county Commissioners of Health, or of State District Health Officers in localities which do not have full-time Health Officers. Stronger collection, transportation, processing, and disposal regulations are under study.

Enactment of this legislation was the first step in a long-range program to deal effectively with solid waste in the State of New York. The program was given additional impetus by the Federal Solid Waste Disposal Act of 1965, which made possible the acceleration of staffing and program development.

The second significant piece of legislation, promulgated in 1966, created what is now the Bureau of Solid Waste Engineering, and authorized 100 percent funding for comprehensive solid waste studies to be conducted by qualified consulting engineers. The State planning grant program encourages county and regional area-wide planning for the collection, treatment, and disposal of all solid wastes. To date, there are nine such projects underway, and several reports are to be published soon.

The third important State-level action directed at a solution to the State's solid waste problem was the creation of the New York State Pure Waters Authority by Chapter 722 of the Laws of New York, 1967. The New York State Pure Waters Authority, a public benefit corporation, can plan, finance (through the sale of bonds), construct, maintain, and operate sewage treatment works and solid waste disposal facilities. A number of flexible arrangements may be reached with the municipality involved. The critical limitation is that the Authority must be invited to participate.

These three significant legislative actions, overlapping and interrelated with other legislation and agency regulations, form the State's basis for effective action. This enabling legislation must be viewed in light of what it permits or requires counties and municipalities to do regarding solid waste collection, storage, treatment, and disposal.

Solid waste collection and disposal services and related regulation are local responsibilities, subject to the State Sanitary Code. The Municipal Home Rule Law, the General City Law, the County Law, the Town Law, the

Village Law, the Public Health Law, and charters of cities and some counties, all contain provisions authorizing units of local government to enact local laws, ordinances, or rules and regulations pertaining to solid waste collection and disposal. Local regulations may prohibit practices which endanger health or property or which result in nuisances. Such regulations may also control private collectors in the interest of ensuring satisfactory collection and disposal service. For example, the Town Law provides authority to regulate the use of any lands for dumps, the collection of garbage, the storage of refuse on private property, the disposal of refuse on town highways, and to control smoke or gases. Likewise, the Village Law provides for authority to regulate any occupation which affects the public health and welfare.

Furthermore, cities, villages, towns, suburban towns, and counties are empowered to provide for refuse removal and disposal on a local basis, either on a municipality- or county-wise basis, or by the establishment of special districts to serve only certain areas. Establishment of service and disposal is subject to procedural regulations in all levels of local and county government, including permissive or mandatory referendum. All levels of local or county government are permitted either to provide the service themselves or to contract for collection and disposal subject to various time limits. The General Municipal Law also provides a wide range of flexibility for intermunicipal service arrangements. Municipalities are empowered to perform any service or function on a cooperative basis that they are now authorized by law to provide on a separate or individual basis. Thus, any two or more municipalities may agree on a cooperative program for refuse collection and disposal; a town and any village or villages within the town are limited to five years in such an agreement. This Law also authorizes New York counties, cities, towns, villages, school districts, and improvement districts to enter into agreement with public agencies in other states either to provide or receive garbage and refuse services across state lines.

Despite the general soundness and sufficiency of the legislative base, there are some aspects that may present problems in achievement of the objectives of the solid waste program. For example, the Pure Waters Authority can assist a local unit of government only if invited to do so. The lack of power to act directly in local situations diminishes the Authority's overall effectiveness. New legislation providing for Pure Waters Authority involvement (without specific local invitation) in situations where current operations are demonstrably sub-standard is one approach to remedying this shortcoming. It would be necessary, of course, to define clearly the circumstances and criteria involved so that a reasonable compromise between local and State authority could be developed. An alternative approach would be to enact legislation permitting the Pure Waters Authority to initiate construction and operation of regional solid waste facilities to which communities would subscribe when their local facilities were used up or phased out.

Another deterrent is the lack of legislation requiring towns, villages, cities, or counties to make provision for refuse disposal, either through direct municipal operation of the refuse disposal area, or through contractual arrangements. All existing laws merely empower or allow the provision of such a service; it is not mandatory. Many local governments not only fail to make provisions for adequate refuse disposal facilities, but do not recognize that it is a municipal responsibility. Administrative control of private refuse collection contractors is now exercised in some instances at the local government level; however, it is optional, and in many cases contractors and control regulations are not adequate.

The Sanitary Code does not now require approval of plans for new, expanded, or converted disposal areas, at their option, the health officers may request submission of such plans. This makes the prospects of adequate operation unpredictable, and virtually defeats an integrated attempt at long-range and interim (with subsequent re-use) land planning. Regulations and specifications on improved collection, transportation, and processing operations also require legislative reinforcement.

STATE AGENCIES

Even with the substantial amount of State legislation affecting solid waste disposal practice, there are only three State agencies with a substantial direct involvement in the solid waste program: Environmental Health Services and Community Health Services in the Department of Health (department organization is shown in Figure 9-1); and the Pure Waters Authority.

Within Environmental Health Services (see Figure 9-2) there are three divisions: Air Resources, Pure Waters, and General Engineering and Radiological Health. (The Division of Pure Waters should not be confused with the Pure Waters Authority.) The Division of Air Resources is responsible for all items found in Article 12A of the Public Health Law and for those items covered in the Rules and Regulations concerning Air Pollution. The Division of Pure Waters is responsible for all items covered in Article 12 of the Public Health Law, and has the additional task of administering the Rules and Regulations primarily concerned with water-carried waste and water supplies. The Division of General Engineering and Radiological Health, which includes the Bureau of Solid Wastes Engineering and Community Environmental Health, is responsible for those items covered in the Public Health Law pertaining to general sanitation and such portions of the State Sanitary Code which are not covered by either the Division of Air Resources or the Division of Pure Waters. In some instances there are areas of dual responsibility; whenever such a case of dual responsibility arises, the ultimate responsibility is assigned by Environmental Health Services to that Division for which the task will be most appropriate.

The Department's normal agreements with other agencies and departments of State government are formal, these agreements generally are in the form of memoranda of understanding, letters of agreement, etc. There are, however, some informal agreements between the Department and other departments and/or agencies. The Bureau of Solid Wastes Engineering plays the leading role in coordinating solid waste planning activity, enforcement of the Sanitary Code, and reviewing and approving plans prepared under the grant program.

Field operations, inspections, actual code enforcement, and consultation are principally the responsibility of the field offices (five Regional and nine District Offices, six City and twenty-eight County Health Units). The Health Regions and Districts and the full-time local Health Departments are shown on Figure 9-3. These field offices are administered by Health Officers who are responsible to Community Health Services within the Department of Health. Each field office organization includes an engineer and a sanitation staff to administer Environmental Health programs. This staff is administratively responsible to the Health Officer, while programmatically responsible to Environmental Health Services.

The district, county, or regional field office priorities are set by the Health Officer, with the actual work being done by the staff. Environmental Health Services is responsible for the supervision and technical advice and guidance needed for the proper administration of the engineering and sanitation staff activities. Any additional work load on the field units must be approved by Community Health Services. There also exists a Health Planning Council within the Department, which coordinates intra-Department functions of health planning, sets priorities, reviews programs, etc. The relationship with other governmental agencies is usually on a commissioner to commissioner basis.

The third major agency with a direct involvement is the Pure Waters Authority. This Authority is a public benefit corporation that can plan, finance (through the sale of bonds), construct, maintain, and operate sewage treatment works and solid waste disposal facilities. This is the only state agency empowered to perform these activities. Municipalities may contract with the Authority for the design and construction of needed facilities. These contracts may provide for either municipal operation of the completed facility or for operation and maintenance of the facility on a continuing basis by the Authority. In addition, the Authority may arrange for the financing of proposed facilities, with design, construction, and operation by the municipality. The Pure Waters Authority views itself as an implementation agency, with duties clearly distinguished from those of the Department of Health, which is charged with the responsibility for solid waste planning and code enforcement. In operation, that distinction is not quite so clear, for the Pure Waters Authority is involved in its own research and planning activities, especially those concerning operation.

The combined activities of these three principal agencies represent the major part of the involvement by State Agencies in solid waste planning, management, and implementation. There are, of course, other agencies having impact on or interest in solid waste disposal as it may affect their primary operations. These include:

The Bureau of the Budget has an impact as it controls State aid and the resources flowing to municipalities which allow some local resources to be used for solid waste management. It also has some power with regard to the planning grant program and funding of environmental programs.

The Department of Audit and Control (Division of Municipal Affairs) becomes directly involved in approving bond issues and creation of special districts, where these are intended for the purpose of public works (in this case, solid waste disposal). The Department also exerts an influence and provides counselling in budget and revenue financing, which has an indirect effect on public works financing of any type.

The Office of Local Government serves as a clearing house for information of common interest to local governments, and was established to help governing bodies work together on mutual problems and to coordinate state programs affecting them. The office, headed by a Commissioner appointed by the Governor, includes the State Board of Equalization and Assessment, which helps local governments administer their real property taxes; the board also establishes equalization rates, which have a bearing on some forms of State aid.

The Office of Planning Coordination administers all community planning work in New York State funded by the Department of Housing and Urban Development, i.e. the 701 projects. Land use and development plans developed under this program have an important bearing on site selection. Proposals for interim and ultimate site use must be coordinated and be compatible with area land use proposals. This office would coordinate that effort and provide demographic data important to the maintenance and updating of local, area, and State-wide solid waste plans.

The Department of Transportation (DOT) exercises a strong influence on development of regional or area-wide plans. It is responsible for researching, planning, designing, constructing, and maintaining all State and federal roadways in the State. It also sets rules and regulations for use of the highways as regards possible changes in vehicles used. The department is fully responsible for the Barge Canal, and shares responsibility with the Corps of Engineers for the other waterways in the State, through State policies, plans, and regulations.

*The Department of Conservation*not only has an interest in solid waste management, but it is also often directly involved in solid waste problems. The Division of Lands and Forests, holding over 3 million acres of recreation land (much of it within the Adirondack and Catskill Forest Preserves), has a tourist waste problem, but disposal sites on these lands are not permitted. The Division of Parks, principally interested in intensive recreation, can provide funds for assistance in developing a site for reuse, providing the need is there and the landfill is phased in such a way as to permit park operation to begin as soon as possible after initial landfill operations. The Division of Mineral Resources is attempting to revise present legislation which will permit it to take over the approval of sites for all sand and gravel extractions, and which will require that some form of reclamation be included in the plan. The reclamation could include landfilling if it can be shown that there will be no detrimental effects on environmental quality. The Division of Water Resources has an interest in the effects, on stream flow and water quality, of topographical and other changes resulting from solid waste disposal activities. The remaining divisions have only marginal interest in or impact on a solid waste program.

The Bureau of Surplus Real Property, Office of General Services has responsibility for lands under water, surplus lands, and unappropriated lands. It acts as a clearing house, handling transfers between agencies. It can donate to municipalities for landfills, but only when the planned reuse is for a park, highway, recreation, reforestation, or mental health.

The Department of Commerce has very little involvement in the solid waste problem. Its principal roles are (or would be) research in techniques and provision of industrial data for detailed solid waste planning activities.

The Department of Agriculture and Markets also has very little direct involvement, although it is concerned with hog-feeding operations and with the disposal of toxic materials such as pesticides, contaminated or condemned food, contaminated animals, and manures (particularly chicken manures). These are special wastes and generally are not easily disposed of by normal landfill procedures without some danger of ground-water contamination.

STATE AGENCIES - SUMMARY

As previously stated, the Pure Waters Authority and the two agencies in the Department of Health currently have and will probably continue to have the critical roles in solid waste management. There is need for an improved structure and for better definition of relationships between and within these three top agencies. For greatest effectiveness, a reorganization under a separate agency may be necessary as the State's involvement in the environmental field increases. A Joint Committee on Environmental Management and Natural Resources of the State Legislature is studying the feasibility of consolidating existing programs and evaluating the need for new programs. Its report is scheduled for publication this year. The interface with other agencies will always have some impact, but only with regard to certain operations or certain elements of the planning, financing, or operating of specific facilities.

CURRENT RESPONSIBILITIES - LOCAL AND STATE

In the section of this chapter covering legislation, three major pieces of legislation were discussed which were important in moving the State of New York forward in the arena of area-wide and State-wide solid waste problem solutions. This is only a first step forward, because the present structure places virtually all responsibility in the hands of local governments and agencies. This is an outgrowth of the historic strength of local prerogative and is reflected in actions by the legislature to curtail State involvement in local affairs in all matters except the area of disbursement of increasing amounts of State aid to local governments.

Cities, towns, and villages, so long as they meet minimum requirements specified in the Sanitary Code, have the power to set their own rules and regulations, to operate their own collection and disposal facilities, or to contract for these services; they use a number of methods to finance these operations and facilities. They may establish districts to serve only parts of the municipality. Counties may also establish districts and provide collection services and disposal, although relatively few have chosen to do so.

Other than State grants for planning studies, there is no direct State-level financial involvement. The Pure Waters Authority acts only by invitation, and Environmental Health Services currently supervises and coordinates the solid waste planning function. Even inspection and enforcement are carried out on a local level. This is discussed in greater detail in the following section.

The imbalance of control in favor of local areas, although rightfully recognizing local prerogative, increases the difficulty of achieving consistency in carrying out the intent of the Sanitary Code. This problem is compounded by the lack of consistent local management. At present, solid waste management rules and regulations apply only to refuse disposal areas and facilities. In all other areas of solid waste management - collection, transportation, processing, etc. - there are few operating or procedural guidelines, and these are not mandatory. This situation leads to a wide variation in the resultant quality of environmental management and has a great impact on the effectiveness and economy of solid waste disposal.

Until the existing State agencies produce a more cohesive policy of implementation and assume a more direct responsibility with regard to local disposal practices, it will be difficult to achieve the objectives of the Solid Waste Planning Program.

ENFORCEMENT AND CONTROL

As defined in Part 19 of the Sanitary Code, regulatory control over refuse disposal sites and municipal incinerators is primarily the responsibility of full-time city and county Commissioners of Health or State District Health Officers. Exemptions or modifications with respect to disposal sites may be granted for dumping control and for compaction and cover, provided the exemption will not result in water or air pollution, a nuisance, or a health hazard. Any exemption must be applied for by the municipality or by private contractor, and must be granted in writing by the responsible health official. Such exemptions are limited to one year and must be renewed annually in writing. The Sanitary Code further provides for enforcement where an unsatisfactory refuse operation in one health district creates a nuisance in another health district. In effect, the health officer having jurisdiction over the refuse disposal site must take action to abate the nuisance. This is the structure as established for enforcement and control of the regulations set forth by the Sanitary Code.

Unfortunately, there are several problems which compromise the intent of achieving satisfactory solid waste disposal throughout the State of New York. First, the county health departments are funded partially from State funds, with the remainder from local funds. The funds are administered on a local level, although the county departments are an integral part of the State-local structure. This brings the enforcement under local political and local economic constraints and does not insure full coordination or comparable standards among county health units or among regional and district units.

Second, it has been found that many county health units cannot justify both an engineer and sanitarians. This weakens the capability of a local health unit to deal with all aspects of solid waste management and control. It is not reasonable for a local health unit to handle all the complex duties of environmental control in addition to all its other roles under the Community Health Services, which also include the Offices of Nursing, Public Health, Social Work, and Rehabilitation Therapies, to name only a few.

A third problem, related to the second, is the difficulty of setting and maintaining priorities with regard to enforcement. Because of insufficient staff, and varying local views as to the priority of environmental control, a working priority system now in effect calls for "...action first against persistent large violators and those that are more visible. Major attention is also given to those places for which a comprehensive regional or county study has been completed, and for which an economical and feasible engineering course of action is available".[1] This suggests the need for a major expansion in field staff, possibly in a new organization, with a clear mandate and power to act immediately and positively.

The last impediment to consistent and effective enforcement and control is the lack of management controls. There is no licensing of private refuse collectors. The Sanitary Code does not now require approval of plans for new sites; submission of plans is optional on the part of the health officer. No plan submission is required for conversion of open dumps to sanitary landfills, for the expansion of existing sites, or for abandonment or termination of a disposal area and its maintenance. Finally, the Sanitary Code does not provide for an annual permit to operate a disposal site. This removes some of the power of enforcement and makes good administrative control for satisfactory operations difficult. An effective permit system would provide the mechanism for dealing with current problems, upgrading existing operations, and planning for the future.

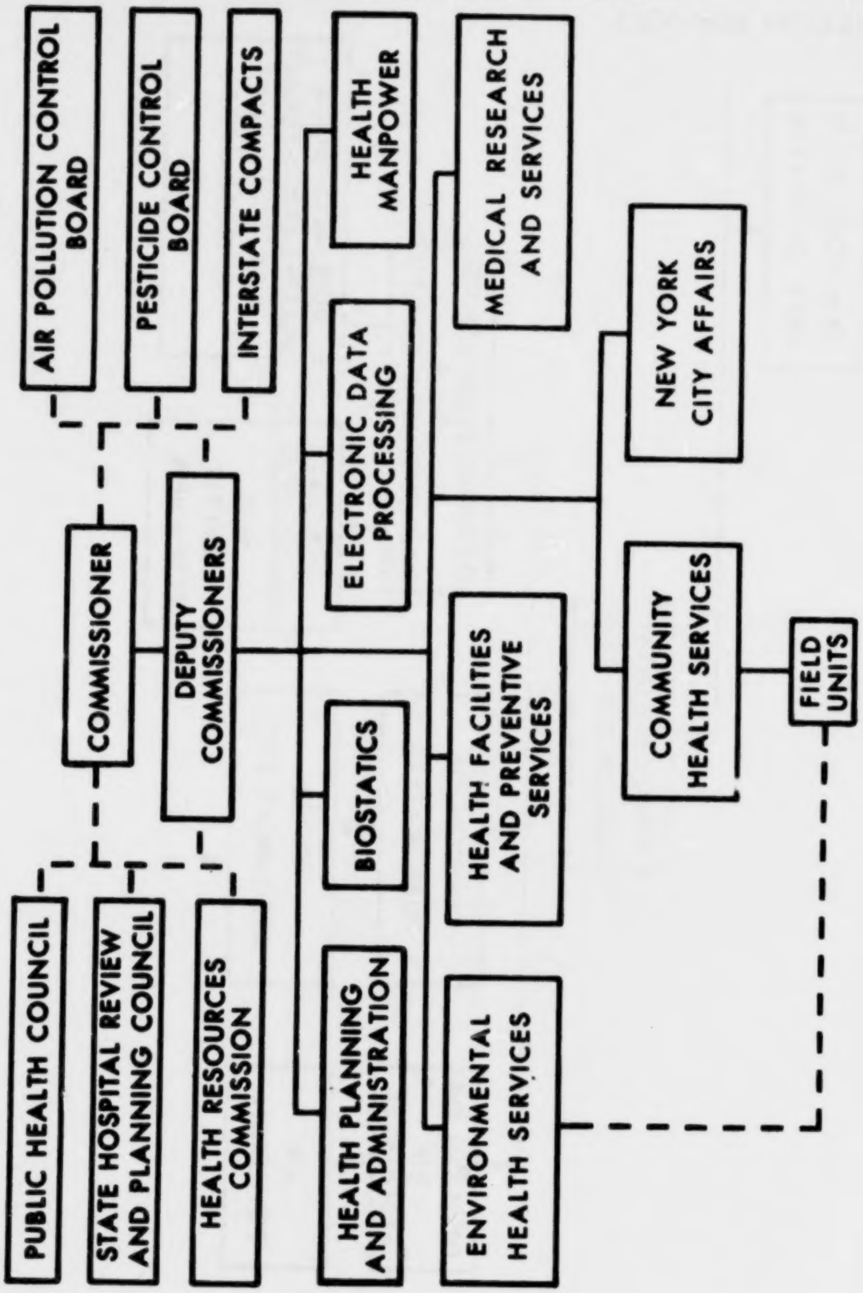
These problems do not mean that enforcement has been totally ineffective; some 700 dumps were eliminated in the six years since Part 19 of the Sanitary Code was enacted. Today, of the 921 land disposal sites still in operation, approximately 50 can be classified as sanitary landfills. During 1968, local health units made some 5,500 inspections of refuse disposal areas and held approximately 2,300 conferences with municipal officials and private contractors to make recommendations and discuss improvement of operation and maintenance of disposal sites. In some cases, where compliance was not forthcoming, fines were levied and collected; this had an impact in encouraging corrective action at other operations in the area. However, there appears to be a definite need for staff expansion and reorganization, and for stricter and broader coverage of the regulations to allow a "main-line" direction and control of solid waste collection, handling, and disposal practices in the State of New York.

---

[1] From a paper prepared by Joseph A. Salvato and William G. Wilkie, Division of General Engineering and Radiological Health, New York State Department of Health, Albany, New York for presentation at the 33rd Annual Education Conference, National Association of Sanitarians, Houston, Texas, June 26, 1969.

ORGANIZATION CHART:
NEW YORK STATE DEPARTMENT OF HEALTH

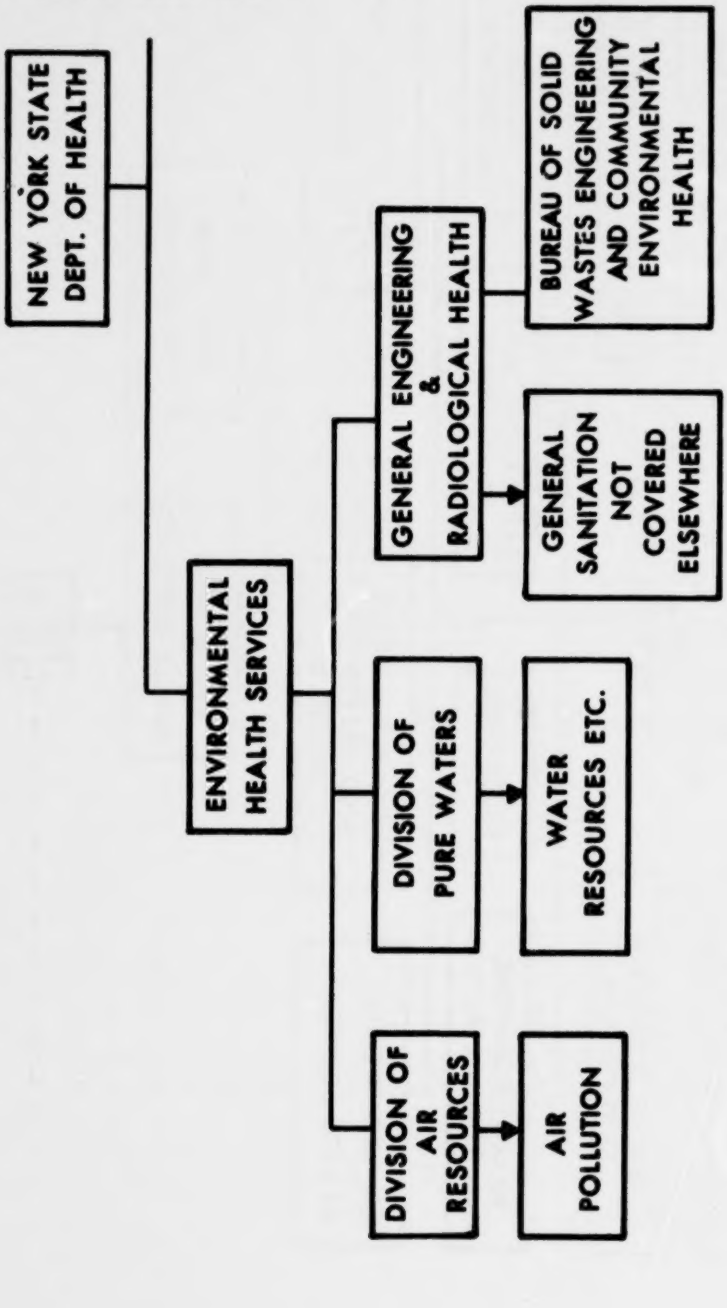
FIGURE 9 - 1



AIR POLLUTION CONTROL BOARD
PESTICIDE CONTROL BOARD
INTERSTATE COMPACTS
HEALTH MANPOWER
MEDICAL RESEARCH AND SERVICES
NEW YORK CITY AFFAIRS
ELECTRONIC DATA PROCESSING
COMMISSIONER
DEPUTY COMMISSIONERS
COMMUNITY HEALTH SERVICES
FIELD UNITS
BIOSTATICS
HEALTH FACILITIES AND PREVENTIVE SERVICES
PUBLIC HEALTH COUNCIL
STATE HOSPITAL REVIEW AND PLANNING COUNCIL
HEALTH RESOURCES COMMISSION
HEALTH PLANNING AND ADMINISTRATION
ENVIRONMENTAL HEALTH SERVICES

ORGANIZATION CHART:
DIVISION OF ENVIRONMENTAL
HEALTH SERVICES

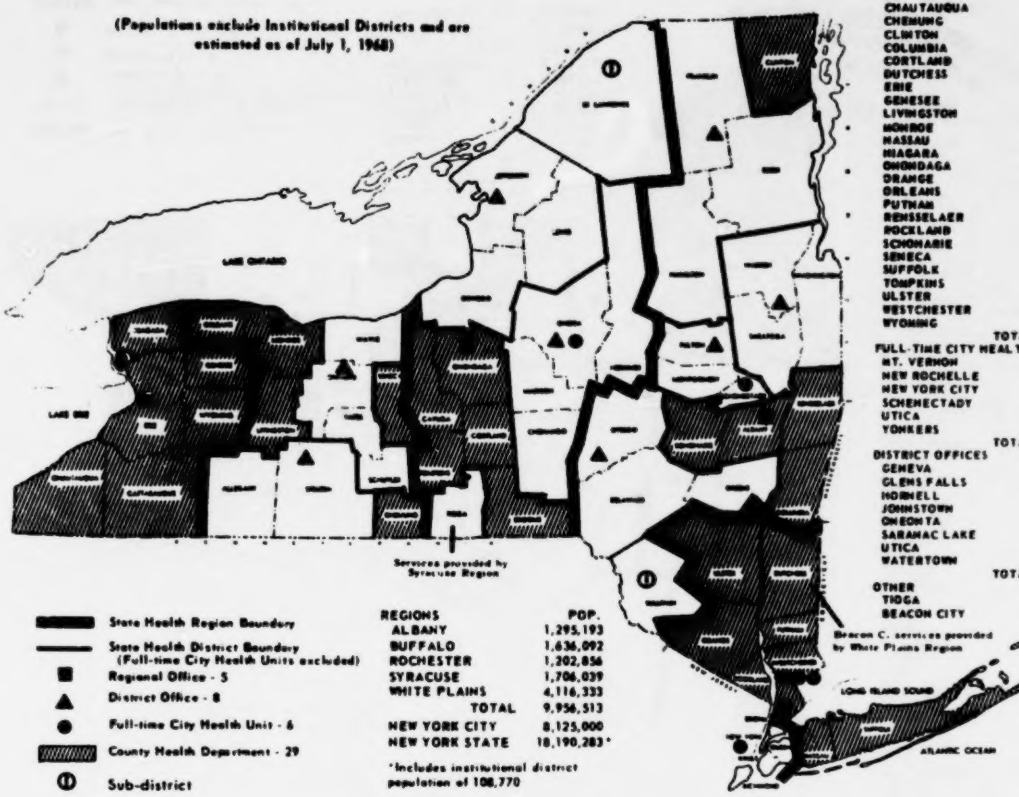
FIGURE 9 - 2


NEW YORK STATE DEPT. OF HEALTH
ENVIRONMENTAL HEALTH SERVICES
DIVISION OF AIR RESOURCES
DIVISION OF PURE WATERS
GENERAL ENGINEERING & RADIOLOGICAL HEALTH
AIR POLLUTION
WATER RESOURCES ETC.
GENERAL SANITATION NOT COVERED ELSEWHERE
BUREAU OF SOLID WASTES ENGINEERING AND COMMUNITY ENVIRONMENTAL HEALTH

HEALTH REGIONS AND DISTRICTS AND LOCAL FULL-TIME HEALTH DEPARTMENTS: NEW YORK STATE DEPARTMENT OF HEALTH; JULY 1, 1968

FIGURE 9-3

(Populations exclude Institutional Districts and are estimated as of July 1, 1968)


LAKE ONTARIO
LAKE ERIE
LONG ISLAND SOUND
ATLANTIC OCEAN
Services provided by Syracuse Region
Beacon C. services provided by White Plains Region

COUNTY HEALTH DEPTS.	POP.
ALBANY	286,764
BROOME	221,864
CATTARAUGUS	79,752
CAYUGA	74,252
CHAUTAUQUA	150,200
CHEMUNG	100,434
CLINTON	76,047
COLUMBIA	49,920
CORTLAND	44,049
DUTCHESS	193,588
ERIE	1,281,197
GENESEE	58,764
LIVINGSTON	46,952
MONROE	661,537
NASSAU	1,437,963
NIAGARA	231,891
ONONDAGA	474,834
ORANGE	209,228
ORLEANS	38,033
PUTNAM	40,265
RENSSELAER	148,685
ROCKLAND	204,080
SCHOHARIE	22,006
SENECA	31,581
SUFFOLK	999,833
TOMPKINS	74,731
ULSTER	140,682
WESTCHESTER	520,092
WYOMING	34,208
TOTAL	7,741,512
FULL-TIME CITY HEALTH DEPTS.	
MT. VERNON	70,150
NEW ROCHELLE	73,504
NEW YORK CITY	8,125,000
SCHENECTADY	69,584
UTICA	74,633
YONKERS	207,247
TOTAL	8,640,118
DISTRICT OFFICES	
GENEVA	182,176
GLENS FALLS	202,020
HORNELL	142,143
JOHNSTOWN	181,690
ONEONTA	176,168
SARANAC LAKE	82,309
UTICA	353,565
WATERTOWN	322,702
TOTAL	1,642,773
OTHER	
TIOGA	45,409
BEACON CITY	11,701

▬	State Health Region Boundary
—	State Health District Boundary (Full-time City Health Units excluded)
■	Regional Office - 5
▲	District Office - 8
●	Full-time City Health Unit - 6
▨	County Health Department - 29
ⓘ	Sub-district

REGIONS	POP.
ALBANY	1,295,193
BUFFALO	1,636,092
ROCHESTER	1,202,856
SYRACUSE	1,706,039
WHITE PLAINS	4,116,333
TOTAL	9,956,513
NEW YORK CITY	8,125,000
NEW YORK STATE	18,190,283*

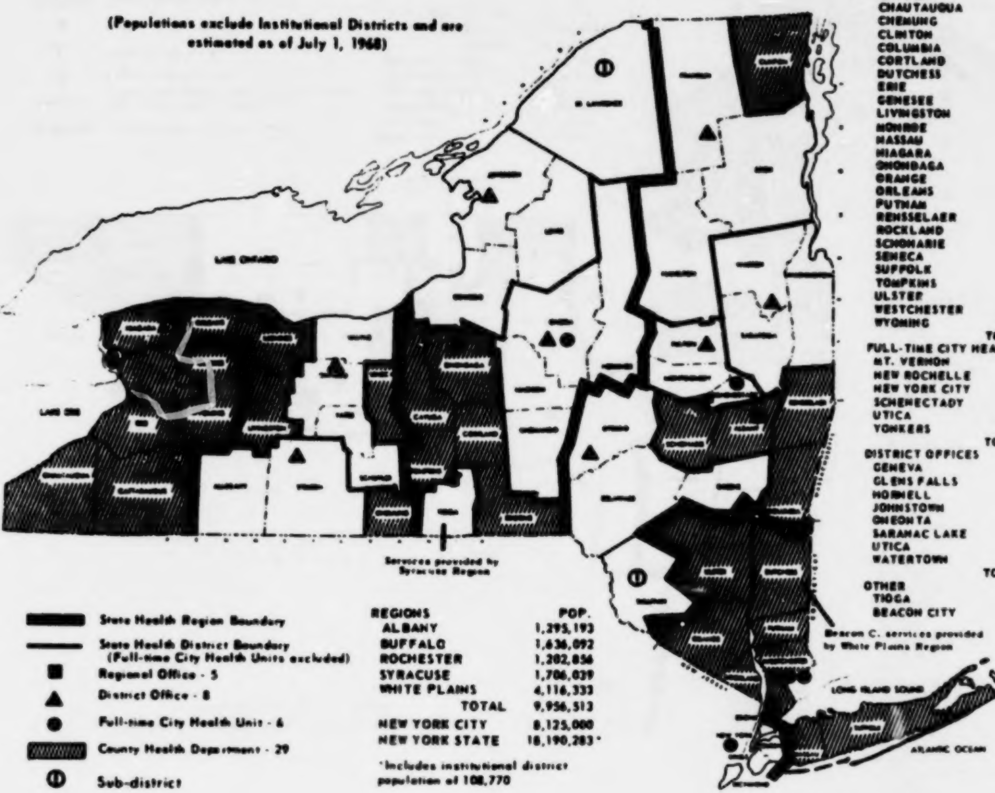
*Includes institutional district population of 108,770

NYSHD - CHS - 6-21 -

HEALTH REGIONS AND DISTRICTS AND LOCAL FULL-TIME HEALTH DEPARTMENTS: NEW YORK STATE DEPARTMENT OF HEALTH; JULY 1, 1968

FIGURE 9-3

(Populations exclude Institutional Districts and are estimated as of July 1, 1968)



Services provided by Syracuse Region

Beacon C. services provided by White Plains Region

COUNTY HEALTH DEPTS.	POP.
ALBANY	286,764
BROOME	221,864
CATTARAUGUS	79,752
CAYUGA	74,252
CHAUTAUQUA	138,280
CHEMUNG	100,434
CLINTON	76,047
COLUMBIA	49,920
CORTLAND	44,049
DUTCHESS	193,588
ERIE	1,081,197
GENESEE	58,764
LIVINGSTON	46,952
MONROE	661,537
NASSAU	1,437,963
NIAGARA	231,891
ONONDAGA	474,834
ORANGE	209,228
ORLEANS	38,033
PUTNAM	48,365
RENSSELAER	148,685
ROCKLAND	204,080
SCHOHARIE	22,006
SENECA	31,581
SUFFOLK	999,833
TOMPKINS	74,731
ULSTER	140,682
WESTCHESTER	520,092
WYOMING	34,208
TOTAL	7,741,512
FULL-TIME CITY HEALTH DEPTS.	
MT. VERNON	70,150
NEW ROCHELLE	73,504
NEW YORK CITY	8,125,000
SCHENECTADY	69,584
UTICA	94,633
YONKERS	207,247
TOTAL	8,640,118
DISTRICT OFFICES	
GENEVA	182,176
GLENS FALLS	202,020
HORNELL	142,143
JOHNSTOWN	181,690
ONEONTA	176,168
SARANAC LAKE	82,309
UTICA	353,565
WATERTOWN	322,702
TOTAL	1,642,773
OTHER	
TIOGA	45,499
BEACON CITY	11,701

Symbol	Legend
▬	State Health Region Boundary
—	State Health District Boundary (Full-time City Health Units excluded)
■	Regional Office - 5
▲	District Office - 8
●	Full-time City Health Unit - 6
▨	County Health Department - 29
⦶	Sub-district

REGIONS	POP.
ALBANY	1,295,193
BUFFALO	1,636,092
ROCHESTER	1,202,856
SYRACUSE	1,706,039
WHITE PLAINS	4,116,333
TOTAL	9,956,513
NEW YORK CITY	8,125,000
NEW YORK STATE	18,190,283*

*Includes institutional district population of 108,770

NYSHD - CHS - 4-21-

CHAPTER TEN

POLITICAL, SOCIOLOGICAL, AND FINANCIAL FACTORS

INTRODUCTION

In addition to the positive factors and accompanying constraints discussed in the preceding chapters, there are other considerations, policies, programs, and questions which have considerable impact on any proposed State-wide program of solid waste management. The political and sociological framework within which government actions are carried out in the State of New York is a formidable factor in applying a solid waste plan that requires inter-governmental cooperation. The degree to which existing vehicles for intermunicipal cooperation are effective, and the general acceptance of them as tools in reaching solutions, must be considered. Finally, the financial resources of local governments and the kind and level of State or federal aid available will be major considerations in implementing a program.

This chapter describes existing political, sociological, and financial conditions and discusses the implications of each on the development of the Solid Waste Management Plan for the State of New York.

POLITICAL AND SOCIOLOGICAL CONSIDERATIONS

Politically, New York is a "home-rule" state. As has been pointed out in several instances in the preceding chapters, virtually all prerogative for action and provision of services lies at the local level. Proposals in the legislature to move away from this base generally encounter strong opposition. The most recent session of the legislature provided an illustration of this political attitude against control at the State level. Legislation to curtail the powers of the Pure Waters Authority and to strip it of the power of condemnation was passed by an overwhelming majority, because the Authority was regarded as a threat to local interest and self-rule even though it may act only by local invitation. Governor Rockefeller intervened and vetoed the legislation.

In a memorandum, Governor Rockefeller commented to the effect that the bill would result in increased costs to the municipalities and that it would nullify the capability of the Pure Waters Authority to assist in developing solutions to solid waste management problems.

An interesting dichotomy in the "home-rule" attitude exists with regard to this issue of local vs. State control. The local areas resist State intervention in control of operations, but constantly demand increasing amounts of financial aid from the State. This is clearly revealed in the current action to revise the general revenue supplement Per Capita Assistance on the basis of the 1970 census. The program was originally instituted on the basis of the 1960 records of municipal population. Because of the "save harmless" criteria, those municipalities which have lost population between 1960 and 1970 demanded and will continue to receive the same aid, even though their needs may not justify their portions of the aid money.

This local prerogative is not restricted to situations involving a local municipality and the State. Westchester County developed a rail-haul proposal to move its waste north along the Hudson River for disposal at large sites in other counties. These counties and the involved municipalities reacted immediately by passing resolutions and ordinances prohibiting the disposal of any wastes other than their own within their boundaries; some towns have even prohibited the disposal of any refuse in their town. Thus, municipalities treasure their independence, and with regard to solid waste they consider the disposal of waste from another municipality a civic affront.

Counties are permitted by law to establish special districts for such activities as solid waste collection and disposal, provided that they follow certain procedural requirements and serve more than one municipality. However, they too encounter local opposition engendered by the "home-rule" spirit. Largely because of this factor, the counties have had limited success in establishing Solid Waste Disposal Districts, only Niagara and Broome counties have been able to set up such Districts.

Conflicts deriving from the power of local prerogative extend even to the level of municipality versus municipality. Under the Village Law, a village may acquire land for the establishment of a refuse disposal area within or outside its corporate limits. Under the Town Law, the Town Board may establish one or more refuse disposal areas in or outside the town. The broad grant of powers to all cities enables them to acquire land in or outside their boundaries for use as refuse disposal sites. When land is purchased or acquired by a village or town within another municipality, such lands can be acquired only with the consent of that municipality. There is no similar requirement for consent where a city acquires land outside its corporate limits.[1] However, more than acquisition of a site is involved. Every municipality has authority to regulate and control refuse disposal within its own boundaries, and permission to operate a refuse disposal site is required in every instance.

The political environment in New York State is not strange when one considers its history and the charter form by which so many of the cities, villages, towns, and counties were established.

In addition to the governmental forms, a number of sociological considerations underlie the reticence to accept the onus of waste disposal. One such consideration is that people have a natural reaction against the disposal of refuse in "their town". The frequent statement that 'no one wants his or someone else's garbage in his backyard' certainly provides an insight into the attitudes of the public. The property owner has paid for his home and has invested in the community by tax payments; consequently, he does not wish his investments destroyed by a garbage pile.

A similar attitude affects proposals such as joining with other municipalities for joint waste disposal programs or accepting refuse from "outside" sources. People view the acceptance of indirect problems as an added burden which will eventually include additional costs. Thus, intermunicipal actions have been attacked on the basis of having to pay taxes to resolve another municipality's problems, with the claim of loss of property values as a justification for such a position. There have been situations where a contractor has proposed establishing a regional sanitary landfill in a town, with an agreement which would provide income in an amount sufficient to eliminate local taxation. The rejection of this type of an arrangement reveals the deep-rooted opposition to these disposal approaches.

Finally, people remember only the bad examples they have seen and react negatively to "a landfill in their town" as being an "ugly eyesore; a source of rats, smoke and stench; and a health hazard".

An intensive program of public relations, coupled with a clearer, stronger, and more direct means of action by State agencies, will be necessary to overcome these political and sociological attitudes if area-wide cooperative solutions are to be realized. Enticement alone has not been effective in other program areas; thus, enticement plus enforcement may be necessary for solid waste management.

---

[1] From Part Four of "Municipal Refuse Collection and Disposal", Office for Local Government, State of New York. (September, 1964).

INTERMUNICIPAL COOPERATION

The question of intermunicipal cooperation has been touched on previously, but warrants additional detail and discussion.

Municipalities have a wide scope for developing intermunicipal service arrangements. They are empowered to perform any service or function on a cooperative basis that they are now authorized by law to provide on a separate or individual basis. Thus, any two or more municipalities may agree on a cooperative program for refuse collection and disposal. Under such an agreement:

1. One municipality could provide service to another;
2. Municipalities could agree on which part of the total service each would provide, or,
3. They could combine in the joint provision of a partial or complete service.

A town and any village or villages within the town may agree, for a period not exceeding five years, for the joint collection and disposal of refuse.

The governing body of a municipality or garbage and refuse district owning a garbage disposal plant may contract with any other municipality or district or other public corporation for the disposal and collection, or disposal only, of garbage and refuse of the contracting party. The contract terms are subject to agreement of the contracting parties, but may not be for a term in excess of five years. Article 14-G of the General Municipal Law authorizes New York counties, cities, towns, villages, school districts, and improvement districts to enter into agreement with public agencies in other states either to provide or receive garbage and refuse services across state lines.

The Town Law allows one municipality to contract with any other municipality, corporation, partnership, or individual for use of a municipally-operated public dump or dumping ground on such terms as may be agreed upon. The term of such a contract cannot exceed two years.

To date, intermunicipal cooperation is still the exception rather than the rule. Less than 35 percent of the some 1,500 municipalities use disposal facilities operated by another unit of local government. Less than five percent provide a collection service for another municipality. This is somewhat surprising when viewed in terms of the higher degree of success of intermunicipal cooperation with regard to sewer and water facilities. However, in all areas of public activity (fire, police, education, etc.), where larger-scale operations generally result in economies, intermunicipal cooperation is still the exception rather than the rule. When viewed in light of the powers allocated to all municipalities and the political and sociological considerations discussed previously, this lack of cooperation is easier to understand.

Two possible approaches to overcoming this lack of intermunicipal cooperation are county districts and unresistably-generous financial incentives. The county district approach, although resisted on political grounds, may be feasible. Article 5-A of the County Law authorizes Boards of Supervisors to create county refuse districts. While such a district may consist of a single area or of two or more non-contiguous areas within a county, it may not, however, consist wholly of territory within any one city, village, or portion of a single town outside a village. In other words, the county district must include territory in two or more component municipalities. Initiative for the creation of a county refuse district may originate with the Board of Supervisors acting on its own motion, by petition from a municipality or special district within the proposed county district, or by petition signed by at least twenty-five owners of taxable real property within the proposed district. After various procedural requirements are met, the Board of Supervisors may issue an order creating the district, subject to approval by the State Comptroller and permissive referendum.

A county refuse district may provide for the collection and disposal of refuse by its own forces and facilities, by private contract, or by arrangement with other municipalities. The administrative head or body of the district may establish a scale of charges for refuse service, subject to appeal to the Board of Supervisors. Rules and regulations may be adopted fixing terms and conditions for refuse service. Cost of equipment and facilities, and of operation and maintenance, may be assessed and collected as ad valorem charges or pursuant to a benefit formula. Capital outlays are financed in accordance with the Local Finance Law. Counties with charter powers acquire authority to regulate refuse practices and provide collection and disposal service.

Under the State Constitution, counties may incur joint debt to finance and provide sewer service in a district crossing a county line. The mechanism to acquire this joint debt requires that the portion of the debt chargeable to each county be apportioned to that county rather than the total debt charged to the district. The debt to finance the sewer service can be acquired outside the bonded indebtedness limitation of each county. As yet no investigation has been made of the applicability of this approach to solid waste collection and disposal.

The potential success of any proposal building upon these provisions for intermunicipal cooperation is a function of the political attitude at the moment. Change from the "home-rule" syndrome may be slow, but could be speeded by changing some permissive functions to obligatory. If such were the case, municipalities might realize that they have to join and cooperate in order to be able to afford compliance.

ECONOMIC AND FINANCIAL FACTORS

The financing of any waste disposal facility is a serious problem now and will become even more serious in the future.

There are no financial mechanisms existing under State law directly applicable to financing of solid waste management systems such as financial assistance for the construction of sanitary landfills. There are, however, other financial mechanisms whereby a local government may obtain funds through its own resources. These include: the general property tax and ad-valorem taxation; the floating of general obligation or special purpose bonds; formation of special districts or special authorities; and general borrowing up to the bonded indebtedness of the locality.

Almost every city in the State has reached its bonded indebtedness limit. Many localities have raised taxes about as high as their residents will let them. Furthermore, an ad-valorem tax is most unpopular in those areas which can afford it the most, and in some instances, need it the most. The special district or authority approach has met with only limited success in the State Legislature or in most communities in the past, and its financial impact is yet unproven.

Towns and villages are becoming economically strapped. Irrespective of the constitutional limitations on real estate taxes or bonding limits as a percent of assessed rateables, the local areas and even many of the counties cannot afford to continue to spend at the present rates. One of the major problems is an over-concern for additional revenues, and insufficient concern for efficiency and economy in all services - existing and pending. One way of achieving economy is to consolidate services such as public works, education, and waste disposal, and to provide them at a higher level of government, where the larger scale of operation can produce economies and can achieve a higher quality of service. On an area or regional basis, proper priorities can be established for the various public services. These financial considerations have already been recognized to a limited extent by some municipalities. In an increasing number of major public works projects, the requests to the Department of Audit and Control for approval of financing are on a two- or three-town special district basis. Because of the delays in gaining approval for funds through bureaucratic structures, it has become necessary for the financing committees to return to the Department of Audit and Control just prior to the start of construction, to request an increased in the allowed bonding for public works. In some cases this has been 40 percent higher than the original request, because of the rapid escalation of construction costs.

At the present time, there are two billion dollars in local bond issues anticipated, and nine billion dollars of bonds outstanding for the next five-year period alone. No estimation has been made on how much this may increase within the next ten years.

The financial picture is not much brighter for the State. Federal and State aid to all areas in the State of New York is high, and the requirements continue to increase; but this trend cannot continue. The amount of State aid has reached such proportions that in the past four years State aid to local governments has amounted to almost 40 percent of the total amount in the fiscal program of State aid to localities between 1926 and the present. There is no indication as to when the State's financial picture may improve, but in any event the State will have to become financially involved in the solid waste program. Several possible avenues of State financial involvement are feasible and will be discussed in Chapter Twenty. It is important to note at the outset, however, that any financial formula must have an enforcement mechanism to ensure that the capital invested in establishing a facility is not wasted because of improper or inadequate operation.

One potential source of outside aid, which has not yet come to fruition, is the Federal Government. The Muskie Bill, S-2005, presently in Congress, proposes construction grants for new solid waste facilities, but unfortunately, makes no provision for grants to entice and insure proper management and operation once a facility is constructed. Hopefully, either by amendment to this bill or by subsequent legislation, the importance of maintaining proper and effective disposal will be recognized.

In essence, then, it appears that new State vehicles for financing, outside the existing structure and methods, are required to insure development of adequate solid waste disposal programs in the State of New York.

PART III

Inventory, Analysis, and Development of Data

INTRODUCTION

Data constitute an essential part of the planning process. Comprehensive, reliable data are required to define the solid waste problem in terms appropriate for its study and solution. More specifically, data are needed to determine existing problem areas, and relevant situations, and, more importantly, to isolate and define the problems and conditions which will have a bearing upon the future. Without this information, it would be difficult to objectively determine needs or set goals.

The preceding chapters have provided a background of the planning area. This part of the report is concerned with providing the information needed to define the magnitude of the solid waste problem in New York State.

DATA REQUIREMENTS (CHAPTER ELEVEN)

This chapter identifies the types of data needed to meet the objectives of this study, why they are needed, and what data sources are available. The primary source of data is the New York State segment of the National Survey of Community Solid Waste Practices.

EXISTING FACILITIES AND LAND DISPOSAL SITES (CHAPTER TWELVE)

Conditions and characteristics of existing land disposal sites and incinerators are presented in this chapter by counties. Also, included in this chapter are operating cost data for landfills, incinerators, and transfer stations, and construction cost data for incinerators.

WASTE PRODUCTION (CHAPTERS THIRTEEN THROUGH FIFTEEN)

The quantities of municipal, industrial, and agricultural solid waste generated in each county in the State for various target years are reported in these chapters. The general methodology used in determining these waste quantities, and the location of concentrations or centers of waste generation are discussed.

SPECIAL WASTES (CHAPTER SIXTEEN)

The magnitude of the special waste problem in New York State is extremely difficult to define at this stage because of the severe inadequacy of specific information. However, some general information is presented on radioactive, wastes, mining wastes, dredgings, special industrial wastes, and water and wastewater treatment sludges. Also, the data needed to properly assess the impact of special waste are defined.

SUPPLEMENTAL DATA REQUIREMENTS (CHAPTER SEVENTEEN)

This chapter focuses on the additional data collection and development required to meet the information needs of subsequent studies. Identified are the additional data required to complete the remaining planning efforts, and the types of data required for the implementation and operation-regulation phases.

CHAPTER ELEVEN

DATA REQUIREMENTS AND SOURCES

INTRODUCTION

The preceding chapters have provided a background of the planning area. Additional information is required to define the problem sufficiently that, when complemented by the background information, an overall State program can be developed. The following information is required:

1. Sources and quantities of solid waste which will require disposal in the future.
2. Capabilities of existing disposal sites and facilities to dispose of the solid waste expected in the future.
3. Environmental, technological, and financial impact of those special wastes whose complex natures present distinct handling and disposal problems.
4. Estimated costs of solid waste disposal in the future.
5. Future conditions which may bear upon solid waste disposal, e.g. land availability, air pollution control regulations.

The primary objective of the data inventory, analysis and development in this study is to provide the above information. Concurrent with this objective is a need to obtain a degree of accuracy sufficient to allow the attainment of the planning objectives. However, solution-oriented information such as precise locations of sites, sizes of facilities, etc. are unnecessarily detailed for the purposes of this study.

DATA SOURCES

To develop this information outlined above, some basic data are required, such as solid waste source and generation data, facility inspection data, cost data, and trend data. However, as lucidly stated in the Interim Report, "to anyone who has attempted to solve a solid waste management problem one fact is evident: little reliable information is available".[1]

The recognition of insufficient data prompted the USPHS in 1966-1968 to sponsor the National Survey of Community Solid Waste Practices, which is currently the most comprehensive source of data for use in developing State solid waste management plans. As previously discussed, the survey of New York State was completed in December 1968 by the Department of Health, and the results were presented in three reports: *Community Description Report*, *Land Disposal Site Investigation Report*, and *Facility Investigation Report*. The *Community Description Report* covers four broad areas: 1) storage, 2) collection, 3) disposal, and 4) budget and fiscal. The two disposal reports, *Land Disposal Site Investigation Report* and *Facility Investigation Report*, cover four areas: 1) operational characteristics, 2) quantitative data, 3) fiscal data, and 4) design features. The results of the survey have been recorded in the Department of Health's Office of Electronic Data Processing for use in study and analysis. Some information is available from county studies financed under the Title IX Grant Program for comprehensive solid waste planning. Other sources of information include reports of various solid waste management studies conducted for governments both within and outside New York State. These studies have provided local data concerning solid waste generation, collection and disposal costs, and facility operations. Another survey will be undertaken by New York State to assess industrial and agricultural solid wastes. This survey will focus on a quantitative description of the waste generated, methods of collection and storage, and disposal locations.

DATA REQUIREMENTS

WASTE PRODUCTION

One of the objectives of this study is to determine the geographical distribution of the quantities and types of solid waste produced in the State for various target years. The general methodology involves determining the number and type of solid waste production units (people) and the solid waste production rates which relate the average quantity of waste produced over a specific period of time to each of the basic units of production (lbs/person/day). By estimating trends and projecting the production units and rates into the future, a multiplication of the production rates by the number of production units for any given year will give the projected waste quantities for that year.

---

[1] "The Foundation Provided by the New National Data", Black, Ralph J., 1968. Proceedings of the Institute for Solid Wastes.

Many previous solid waste management studies have based waste production on arbitrarily-selected production rates which varied widely from area to area. These rates rarely accounted for all types of solid wastes, and thus they are not applicable throughout New York State, however, their variability does reflect the dependency of waste production rates on the makeup of the community or area studied. Solid waste production has been shown to be dependent on many variables, ranging from population density to type of heating fuel used to the season of the year. Certain wastes, such as residential wastes, are primarily a function of demographic characteristics, while other wastes such as agricultural manure are not. Thus, to use only one production rate to define all wastes for every community and area in New York State would be insufficient.

As will be discussed later in this report, it was decided to group wastes in the categories of municipal, agricultural, and industrial, and determine production rates for elements of these groupings. These categories of waste are so particularly different that the policies for overall waste disposal management are unique for each. One is primarily in the public sector, while the other two are in the private sector with one being predominantly urban and the other rural.

Production rates should be related to specific sources of production in a manner conducive to estimating the waste produced as distinguished from waste collected. Determining quantities of wastes accepted at landfills and incinerators may accurately represent current or historic collection rates, but a considerable amount of waste material generated in any area is never collected. This is due to on-site disposal of some industrial waste, backyard burning of domestic refuse, in-field burning of some agricultural refuse, salvaging of some waste, incineration of refuse in many apartments, grinding garbage to sewers, etc. These practices will undoubtedly change, possibly significantly, in the near future. Therefore, extrapolation of historic data is not an acceptable approach to the projection of future waste quantities.

SITES AND FACILITIES

Data is needed about sites and facilities to determine their general capability, both now and in the future, for economical disposal of solid waste without adverse environmental effects. If this capability is deemed insufficient, data are needed to indicate what aspects of solid waste disposal management are deficient and, possibly, what improvements are needed. In this sense, the information required includes capacities, remaining life, cost, environmental effects, and any special capabilities.

SPECIAL WASTES

The types of special wastes generated in New York State are numerous, diverse, and complex. Data are needed to point out the nature and magnitude of the problems associated with their handling and disposal. This would permit an identification of general situations which have the potential for polluting the air or water, or for causing public nuisances and health hazards. These data will also indicate any need for changes in planning and management policies.

COSTS

Many factors are involved in environmental decision making; and cost is one of the most important. The cost of solid waste collection and disposal is high--very high. In fact, getting rid of solid waste in an acceptable manner is a municipality's third highest expense--exceeded only by school and road programs. Information on collection and disposal costs is needed at the State level, along with other relevant information (e.g. tax base, bonded indebtedness), to ascertain the competition of solid waste disposal activities for public funds and the ability of certain areas to provide revenues to match increasing demands. With this knowledge, an appropriate allocation of State funds can be made to support solid waste disposal activities without unjustifiably reducing other State programs.

CHAPTER TWELVE

EXISTING FACILITIES AND LAND DISPOSAL SITES

GENERAL

Facilities and land disposal sites were investigated in the State-wide solid waste survey to determine their operating characteristics and capabilities. The results of the survey were presented in two reports: *Land Disposal Site Investigation Report* and *Facility Investigation Report*. Only the authorized sites and facilities of such magnitude as to warrant attention by local or State authorities were surveyed. Not included were on-site facilities such as apartment incinerators and those facilities and sites privately owned and operated by industrial, commercial, or institutional establishments exclusively for their own use.

Proper understanding of the definition or meaning of sites, facilities, systems and related terms is important. Unfortunately, their usage in various solid waste studies has tended to confuse; sites seem to refer only to landfills, and incinerators seem to be the only kind of solid waste disposal facility. In reality, however, sites and facilities each cover a variety of activities and operations. For example, a transfer station facility is located at a transfer station site and is part of a solid waste transportation and handling system.

LAND DISPOSAL SITES

The final step in the disposal of solid wastes is the ultimate return of wastes to the land, air, or water. Although extensive use is made of the air resource via incineration and open burning, and although some dumping is practiced at sea (as discussed in the Water-Haul Methods and Practices section of Chapter Seven), the depositing of refuse on land is by far the most widely used method in New York State.

CHARACTERISTICS OF LAND DISPOSAL SITES

The disposal of waste on land is considered to be the oldest method ever used, and it has almost always had an image of being a public nuisance. Until recently this impression was justified; however, due in part to some pioneering work done by New York City in the 1930's in developing the sanitary landfill method (1), disposal on land can now be accomplished effectively and economically without nuisances. The major aspects of sanitary landfill include: 1) proper placing, compaction, and drainage to prevent water pollution; 2) covering refuse to prevent vector problems; and 3) complete restriction on burning to prevent air pollution.

Table 12-1, a listing of the various operational characteristics of sites as taken from the State-wide survey, indicated 66 percent of the sites pollute the air with the particulate matter and malodors resulting from open burning. The improper drainage noted at 18 percent of the sites makes them vulnerable to washing of refuse into surface waters, as a result of stormwater flushing. Other sites have leaching problems (18 percent of the total) or place refuse below the ground-water table (15 percent of the total); either of these conditions contributes to the danger of chemical and/or biological impairment of the ground water. Threats to the health and well-being of the public are indicated by the rodent problems, which were reported at 44 percent of the sites in New York State, and by the flies, odor, and dust problems that are uncontrolled at 31 percent of the sites.

The U. S. Public Health Service Solid Waste Training Section has developed a rating system for landfills which can, through an assignment of numerical values, indicate the apparent effectiveness of landfills for proper disposal of solid wastes. However, the State-wide survey did not provide enough information to rate the land disposal sites by the USPHS tentative rating method. Actually, the information provided could expressly answer questions covering only 22 of a total of 100 points. However, it is possible to glean from the information whether or not a particular site meets many of the criteria for a sanitary landfill. Only 51 sites of the total 921 sites in the State are reported to meet all of the following criteria:

1. Refuse is covered daily.
2. Site is sightly.
3. Flowing paper is controlled.
4. No burning is permitted.
5. No leaching problems are experienced.
6. No surface drainage problems are experienced.
7. Any rodent, fly, bird, dust or odor control programs needed are provided.
8. Lowest part or fill is not below ground water table.

These 51 sites collectively provide disposal service for only a population of 620,000 people. (No New York City sites are included in this group.) As part of the State-wide survey, the investigator of each site was to report if the site is a sanitary landfill. Of the 921 sites investigated, 168 were judged to be sanitary landfills as compared to only 51 sites reasonably characterized as sanitary landfills based on the preceding evaluation. This same trend (rejection of about two-thirds of the sites judged to be sanitary landfills) was also encountered in the national survey. As expressed in *An Interim Report - The National Solid Wastes Survey* (2) prepared by the USPHS, "this would suggest that perhaps there is some confusion about this term (sanitary landfill), and that some retraining is in order".

A re-inspection of 26 of these sites in the summer of 1969, revealed that only 13 were meeting "sanitary" requirements. Thus, it is apparent that operations can vary. In fact, a sanitary landfill can become unsanitary in one day if daily cover is not provided.

CAPACITIES OF LAND DISPOSAL SITES

The unused capacities of existing sites are important data in developing a solid waste disposal plan. Unfortunately, this type of data is scarce. Not even the National Survey of Community Solid Waste Practices yielded significant information on unused disposal areas or unused capacities. However, the National Survey data on anticipated life and usable land disposal area of each site are helpful in the determination of unused capacity.

Tables 12-2 and 12-3 list the reported information on a county-wide basis. The county totals and State totals are not complete because remaining life was not reported for 27 percent of the State sites, and usable land disposal area was not reported for 25 percent of the State sites; however, most of these serve populations of 5,000 or less. Thus, the information reflects the best available estimate of remaining site life.

The information in Table 12-2 shows that there are very few large-scale land disposal operations in New York State. Only 4 percent of the State sites have 100 acres or more for use; however, these sites account for close to half of the total land used in the State for land disposal.

While Table 12-3 is limited somewhat by the lack of data on the life and area of a number of sites, its information indicates some counties will not require any significant increase in capacity in the next 5-10 years, but many other counties will be using up most of the remaining capacity in five years or less. Overall, 40 percent of the sites will be exhausted in five years or less. It should be noted that when estimating remaining site life during the survey, the assumption was made that existing operating conditions will continue in the future. This is doubtful at the many sites which practice open burning.

Open burning reduces the volume of refuse, and if banned because of its impact on air quality, two-thirds of the sites in the state would start consuming land at a much greater rate. However, technological advances in such areas as compaction and shredding should greatly modify this relationship. For example, compaction can accomplish approximately the same degree of reduction in refuse volume as does open burning.

The impact of tighter operational control on landfill site capacity and the increasingly stringent water pollution control regulations threaten the continued use of many sites; therefore, many communities and counties with apparently sufficient land disposal capacity may have to find new sites far sooner than they had anticipated. However, the true magnitude of land usage problems is not known for the majority of disposal sites, because many reports did not estimate unused areas, much less the unused capacity. If consumption rates are needed for planning purposes, a rate of 6-9 acre feet per year for 10,000 people is reasonable.

FACILITIES

Solid waste facilities include incinerators, grinders, crushers, transfer stations, compost plants, conical burners, and hog feeding lots. Solid waste facilities are used to alter the form of solid wastes to facilitate subsequent transportation and disposal. Although they may provide for disposal of some refuse, they cannot provide for complete disposal. In the State-wide preliminary survey, 77 incinerators[1], 12 transfer stations, 5 hog feeding lots and 1 conical burner were investigated.

INCINERATORS

Table 12-4 is a listing of county-wide incinerator data; as indicated in the footnotes, some assumptions had to be made and some supplemental data were required from New York State Department of Health to complete this table. The principal advantage of an incinerator (centralized location) is reflected by this table - the weighted distance of the incinerators in the State to the population centers served is 4.8 miles.

Although a considerable number of incinerators are in operation in the State, many of them are approaching or are well past the useful life of 20 years considered to apply to incinerators. New air pollution control regulations also threaten the continued use of many others. Preliminary evaluations indicate it is probable that no incinerator built prior to 1961 will meet these regulations, and possibly none built prior to 1964. Only the newer incinerators have air pollution equipment or have the capability to add satisfactory air pollution equipment at a reasonable cost. Only 20 incinerators have been built since 1961 and these account for only 30 percent of the total capacity in the State; of these 20 post-1961 incinerators, 10 have been built since 1964, and they account for only 13 percent of the total capacity. Table 12-5 is a listing of the survey information which pertains to the environmental aspects of the incinerators in the State. This information is far from being sufficient to determine the feasibility of the future use of any incinerator.

---

[1] Four sewage sludge incinerators were also investigated.

OTHER FACILITIES

There are twelve transfer stations in New York State; nine of these are located in New York City. The New York City transfer stations all have a rated capacity of 1,500 tons/day, an average age of 21 years, and are operated at equivalent rates ranging from 250 tons/day to 3,000 tons/day. The other three are located in Broome, Erie, and Otsego Counties. They have a much smaller capacity and have an average age of only 6 years. Only one of the twelve transfer stations (the oldest one) is thought to be unsightly; four transfer stations are deemed to have dust problems, but none has a dust control program.

There are 48 hog-feeding lots with a hog population of 100 or more each; together they dispose of 139 tons per day of garbage, primarily from commercial sources. Five hog-feeding lots, located in Albany, Genesee, and Rensselaer Counties, collectively dispose of close to 1,000 tons annually of garbage from commercial, agricultural, and institutional activities. One lot has been operated for only 4 years while the average age of the others is 24 years. This method of disposal is not envisioned as playing a significant role in the future because of the necessity of segregating and cooking the wastes.

COSTS

Cost information was reported by the preliminary State-wide solid waste survey. Included are annual operating cost data for practically all sites and facilities and replacement cost data for most facilities. From this information, unit cost per ton values can be calculated for those sites and facilities which reported annual tonnage handled or design capacities.

LAND DISPOSAL SITES

The calculated operating cost per ton for the land disposal sites in New York State vary considerably. Throughout the operational size range of 500 to 100,000 tons handled per year, the costs varied by a factor of more than ten. This variation reflects the innumerable cost and operating variables that can exist at land disposal operations. While some sites may be nothing more than open dumps, the operations at other sites may closely follow sanitary landfill standards even though a poor site location may require extensive site maintenance or hauling suitable cover material.

In an attempt to reduce this wide variation in cost, sites which were reported to be sanitary landfills and covered daily, were selected for comparison. Even with these restrictions, the costs will show a wide degree of variability. Figure 12-1 illustrates this variability. Also shown in this figure is a cost relationship developed from information reported in a sales publication (3) by an equipment manufacturer. The theoretical cost relationship is for properly-operated and maintained landfills handling a minimum of 60,000 tons of refuse per year, but has been extended to cover the range of tonnage handled by sites in New York State. For the most part, the theoretical costs are higher, which is probably due to the cost-cutting practices of inadequate landfills.

INCINERATORS

Fifty incinerators located in New York State reported operating costs ranging from $0.21 to $28.00 per ton handled. The wide variation in costs is difficult to account for, because the limited data provided by the survey are too general. Therefore, no reasonable unit cost versus design capacity relationship can be formulated. Most of the incinerators in New York State are operating at costs much lower than the theoretical costs reported in the literature (3). For purposes of comparison: Rogus (4) asserted that a modern, 1,000-TPD incinerator would cost $4.70 per ton to operate (excluding amortization); the results of the National Solid Waste Survey (2) indicated that the older incinerators without air pollution equipment operate at an average cost of $4.05 to $5.37 per ton, while newer incinerators, which tend to have air pollution equipment, operate at an average cost of $3.27 per ton.

Forty-five incinerators also provided information about replacement costs based on estimates of current design and construction costs. Significantly, 50 percent of the estimates fall in the range $6,000-$12,000 per design ton, and only 15 percent of the estimates are higher than $12,000. In contrast, a recent study by Rogus (4) indicates that capital costs for new plants are much higher; a rather detailed estimate for a modern 1,000 TPD incinerator gave a figure of $12,500 per ton, and smaller incinerators obviously have higher per ton capital costs than this. Tighter operating controls, air pollution abatement, and the increased demand of the solid waste problem have all put a premium on incinerator versatility and efficient operation. These factors coupled with the rising cost of labor and materials suggest capital costs of at least $12,000 per ton.

TRANSFER STATIONS

Ten truck to truck transfer stations in New York State provided enough data to calculate unit operating costs. The costs vary from $0.02 to $1.60 per ton handled. The average operating cost for transfer stations as reported by the National Solid Wastes Survey is $1.10 per ton, somewhat higher than those reported for the New York transfer stations.

REFERENCES

1. Banta, J., *et al. Sanitary Landfill,* ASCE Manual of Engineering Practice - No. 39, American Society of Civil Engineers, New York, N. Y. (1959).

2. Black, Ralph J., *et al, The National Solid Wastes Survey-An Interim Report,* USPHS, October 1968.

3. Bell, John M., "Sanitary Landfills," *Facts for Allis-Chalmers Top Salesmen,* April 1968.

4. Rogus, C. A., "Incinerator Costs," *APWA Reporter,* March 1969.

Conditions of Land Disposal Sites

Number of Sites

County	Total No. of Sites	Sites Located in Gully or Canyon	Sites Located in Marsh, Tidal, Flood Plain	Sites Not Covered	Sites with Uncontrolled Burning	Sites with Controlled Burning	Sites with Leaching Problems	Sites with Surface Drainage Problems	Sites with Rodent Problems and Control Programs Not Provided	Sites with Problems Other than Rodents and Control Programs Not Provided	Sites Located Below Ground Water Table
Albany	11	2	2	0	0	5	1	2	2	2	4
Allegany	18	2	1	6	8	5	10	8	5	1	11
Bronx	2	0	0	0	0	0	0	0	0	3	2
Broome	14	1	1	0	4	0	0	0	4	1	0
Cattaraugus	23	0	1	18	18	8	3	2	17	0	0
Cayuga	25	0	2	8	21	1	2	17	23	5	3
Chautauqua	25	2	0	2	13	4	4	5	13	8	1
Chemung	10	1	1	1	1	3	1	0	7	1	3
Chenango	23	0	0	4	14	2	7	7	20	0	0
Clinton	15	0	0	3	4	5	0	0	1	1	0
Columbia	15	5	4	4	5	2	2	2	7	8	1
Cortland	15	3	1	5	16	0	1	3	14	8	0
Delaware	18	1	2	6	7	0	0	0	8	7	1
Dutchess	28	1	3	3	18	7	1	5	21	25	1
Erie	38	5	6	1	12	1	10	15	4	4	8
Essex	17	0	1	8	14	2	7	3	4	7	0
Franklin	18	0	1	13	14	4	1	3	8	4	1
Fulton	9	1	0	4	4	1	1	3	6	4	0
Genesee	14	0	1	1	13	0	0	0	5	0	1
Greene	9	5	1	3	2	4	0	1	1	4	0
Hamilton	11	1	1	10	10	1	8	3	1	4	0

Source: New York State portion of National Survey (1980)

Table 12-1
(continued)

County	Total No. of Sites	Sites Located in Gully or Canyon	Sites Located in Marsh, Tidal, Flood Plain	Sites Not Covered	Sites with Uncontrolled Burning	Sites with Controlled Burning	Sites with Leaching Problems	Sites with Surface Drainage Problems	Sites with Rodent Problems and Control Programs Not Provided	Sites with Problems Other than Rodents and Control Programs Not Provided	Sites Located Below Ground Water Table
Herkimer	14	0	4	0	9	1	9	7	7	13	9
Jefferson	24	2	0	8	18	4	7	7	3	0	2
Kings	1	0	0	0	0	0	0	0	0	0	1
Lewis	13	1	0	6	12	1	6	4	6	0	1
Livingston	19	2	0	2	11	1	5	2	10	11	1
Madison	17	2	1	6	6	3	3	2	6	6	2
Monroe	23	7	2	4	1	5	0	4	2	5	5
Montgomery	11	0	0	7	9	0	0	0	10	10	0
Nassau	5	0	2	0	0	0	2	0	1	5	7
New York	0	0	0	0	0	0	0	0	0	0	0
Niagara	8	0	0	1	4	2	0	2	4	0	2
Oneida	31	7	8	11	13	11	17	11	18	28	18
Onondaga	19	1	5	0	3	6	2	2	10	5	7
Ontario	12	0	0	0	3	1	0	0	0	0	0
Orange	28	1	3	13	10	7	3	2	14	15	7
Orleans	16	1	0	1	13	0	3	3	2	0	0
Oswego	20	2	1	6	13	3	5	3	2	0	1
Otsego	16	2	4	5	8	1	3	1	9	6	3
Putnam	6	0	0	0	4	0	0	0	3	5	1
Queens	3	0	0	0	0	0	0	0	0	0	3
Rensselaer	14	3	1	1	4	2	0	2	8	6	1

Table 12-1
(continued)

County	Total No. of Sites	Sites Located in Gully or Canyon	Sites Located in Marsh, Tidal, Flood Plain	Sites Not Covered	Sites with Uncontrolled Burning	Sites with Controlled Burning	Sites with Leaching Problems	Sites with Surface Drainage Problems	Sites with Rodent Problems and Control Programs Not Provided	Sites with Problems Other than Rodents and Control Programs Not Provided	Sites Located Below Ground Water Table
Richmond	3	0	0	0	0	0	0	0	0	0	3
Rockland	4	0	1	1	0	1	6	2	2	1	2
St. Lawrence	39	2	0	2	37	0	0	5	20	0	4
Saratoga	19	6	3	0	1	3	2	0	2	3	2
Schenectady	5	1	1	2	1	2	1	1	2	4	2
Schoharie	10	0	0	2	4	2	1	1	8	0	1
Schuyler	3	0	0	0	1	0	0	0	1	0	0
Seneca	10	1	0	1	8	0	3	3	7	8	1
Steuben	19	2	5	4	13	2	6	4	13	8	8
Suffolk	26	5	1	2	3	11	2	1	0	8	5
Sullivan	22	0	0	12	9	5	4	2	16	17	0
Tioga	5	0	0	1	5	0	1	1	4	3	0
Tompkins	8	0	1	1	8	1	0	0	2	0	2
Ulster	20	3	0	8	11	3	1	0	11	12	0
Warren	12	2	3	2	5	3	1	3	4	6	1
Washington	14	0	2	5	4	0	0	3	7	7	1
Wayne	13	1	2	1	5	0	4	3	1	1	2
Westchester	19	2	2	2	3	8	0	0	6	4	1
Wyoming	14	4	0	3	13	1	7	7	11	0	0
Yates	8	0	0	0	4	0	1	0	0	0	1
TOTALS	821	90	81	220	470	141	164	188	404	290	140

Table 12-2

Land Disposal Area

County	Total Number of Land Disposal Sites	Land Disposal Area: No. of Sites: 0-99 Acres	Land Disposal Area: No. of Sites: 100-499 Acres	Land Disposal Area: No. of Sites: >500 Acres	Land Disposal Area: Total Acres: 0-99 Acres	Land Disposal Area: Total Acres: 100-499 Acres	Land Disposal Area: Total Acres: >500 Acres	Land Disposal Area Unknown No. of Sites: Population Served: ≤ 5,000	Land Disposal Area Unknown No. of Sites: Population Served: ≥ 5,000	Total Area Used for Land Disposal Acres	Total Sites Are Acres
01 Albany	11	10	1	0	78	215	0	0	0	291	316
02 Allegany	18	18	0	0	143	0	0	0	0	143	258
03 Bronx	2	2	0	0	87	0	0	0	0	87	112
04 Broome	14	1	0	0	5	0	0	6	7	5	6
05 Cattaraugus	23	23	0	0	90	0	0	0	0	90	94
06 Cayuga	25	1	0	0	5	0	0	23	1	5	5
07 Chautauqua	25	1	0	0	5	0	0	18	6	5	64
08 Chemung	10	7	0	0	93	0	0	2	1	93	345
09 Chenango	23	20	0	0	88	0	0	3	0	88	94
10 Clinton	15	8	1	0	61	200	0	5	1	261	261
11 Columbia	15	14	1	0	103	100	0	0	0	203	208
12 Cortland	15	7	1	0	31	100	0	7	0	131	132
13 Delaware	16	4	0	0	12	0	0	11	1	12	105
14 Dutchess	28	25	2	0	319	281	0	0	1	600	608
15 Erie	26	12	1	0	315	100	0	3	10	415	530
16 Essex	17	16	0	0	173	0	0	1	0	173	196
17 Franklin	19	17	0	0	107	0	0	2	0	107	108
18 Fulton	9	3	0	0	56	0	0	4	2	56	55
19 Genesee	14	5	1	0	37	120	0	8	0	157	159
20 Greene	9	8	0	0	62	0	0	1	0	62	330
21 Hamilton	11	8	0	0	25	0	0	3	0	25	25

Source: Data extracted by Consultant from data collected by New York State during National Survey (1968)

Table 12-2
(continued)

County	Total Number of Land Disposal Sites	Land Disposal Area						Land Disposal Area Unknown No. of Sites		Total Area Used for Land Disposal
		No. of Sites			Total Acres			Population Served		
		0-99 Acres	100-499 Acres	≥500 Acres	0-99 Acres	100-499 Acres	≥500 Acres	< 5,000	≥ 5,000	Acres
22 Herkimer	14	12	0	0	162	0	0	1	1	162
23 Jefferson	24	16	1	0	209	290	0	6	1	499
24 Kings	1	0	1	0	0	297	0	0	0	297
25 Lewis	13	12	0	0	40	0	0	1	0	40
26 Livingston	19	18	0	0	101	0	0	1	0	101
27 Madison	17	16	0	0	124	0	0	1	0	124
28 Monroe	23	19	2	0	268	220	0	1	1	488
29 Montgomery	11	8	0	0	63	0	0	2	1	63
30 Nassau	8	6	1	0	136	195	0	0	1	331
31 New York	0	0	0	0	0	0	0	0	0	0
32 Niagara	8	6	1	0	106	105	0	0	1	211
33 Oneida	31	24	1	1	273	200	500	3	2	973
34 Onondaga	19	4	1	0	110	146	0	6	8	256
35 Ontario	12	12	0	0	197	0	0	0	0	197
36 Orange	28	26	2	0	328	362	0	0	0	690
37 Orleans	16	10	0	0	122	0	0	5	1	122
38 Oswego	20	16	0	0	157	0	0	3	1	157
39 Otsego	16	12	0	0	68	0	0	4	0	68
40 Putnam	6	4	0	1	46	0	500	0	1	546
41 Queens	3	1	2	0	35	323	0	0	0	358
42 Rensselaer	14					0	0	1	1	229

Table 12-2
(continued)

County	Total Number of Land Disposal Sites	Land Disposal Area						Land Disposal Area Unknown No. of Sites		Total Area Used for Land Disposal	Total Sites Area
		No. of Sites			Total Acres			Population Served			
		0-99 Acres	100-499 Acres	≥500 Acres	0-99 Acres	100-499 Acres	≥500 Acres	< 5,000	≥ 5,000	Acres	Acres
43 Richmond	3	0	1	2	0	180	2,166	0	0	2,346	2,388
44 Rockland	4	3	0	0	94	0	0	0	1	94	94
45 St. Lawrence	39	8	2	0	285	260	0	26	3	545	545
46 Saratoga	19	17	2	0	458	450	0	0	0	908	937
47 Schenectady	5	4	0	0	80	0	0	1	0	80	166
48 Schoharie	10	9	0	0	54	0	0	1	0	54	71
49 Schuyler	3	3	0	0	65	0	0	0	0	65	65
50 Seneca	10	9	1	0	175	100	0	0	0	275	312
51 Steuben	19	19	0	0	202	0	0	0	0	202	332
52 Suffolk	26	23	1	0	536	100	0	1	1	636	701
53 Sullivan	22	21	1	0	262	112	0	0	0	374	374
54 Tioga	5	5	0	0	21	0	0	0	0	21	34
55 Tompkins	8	5	0	0	82	0	0	2	1	82	82
56 Ulster	20	19	1	0	492	137	0	0	0	629	668
57 Warren	12	11	1	0	103	126	0	0	0	229	229
58 Washington	14	12	2	0	173	255	0	0	0	428	428
59 Wayne	13	13	0	0	242	0	0	0	0	242	310
60 Westchester	19	5	0	0	61	0	0	4	10	61	101
61 Wyoming	14	13	1	0	32	100	0	0	0	132	137
62 Yates	8	8	0	0	62	0	0	0	0	62	88
State Totals	921	651	34	4	8,145	5,074	3,166	167	66	16,385	19,328

Table 12-3

Remaining Land Disposal Site Life

County	Number of Land Disposal Sites	Remaining Life No. of Sites			Remaining Life Unknown No. of Sites Population Served		Land Disposal Area Acres			Land Disposal Area Unknown No. of Sites		
		0-5 Years	6-10 Years	>10 Years	<5,000	≥ 5,000	0-5 Years	6-10 Years	>10 Years	0-5 Years	6-10 Years	>10 Years
01 Albany	11	5	2	3	1	0	35	10	239	0	0	0
02 Allegany	18	13	2	3	0	0	27	81	35	0	0	0
03 Bronx	2	2	0	0	0	0	87	0	0	0	0	0
04 Broome	14	3	2	0	5	4	5	0	0	2	2	0
05 Cattaraugus	23	1	0	0	20	2	1	0	0	0	0	0
06 Cayuga	25	3	2	1	18	1	0	5	0	3	1	0
07 Chautauqua	25	0	1	0	18	6	0	0	0	0	1	0
08 Chemung	10	4	3	1	0	2	50	8	25	1	1	0
09 Chenango	23	0	0	0	22	1	0	0	0	0	0	0
10 Clinton	15	5	0	6	3	1	8	0	53	3	0	0
11 Columbia	15	5	2	8	0	0	19	21	163	0	0	0
12 Cortland	15	6	2	2	5	0	16	10	104	3	0	0
13 Delaware	16	3	0	0	12	1	6	0	0	0	0	0
14 Dutchess	28	4	1	6	12	5	36	10	286	0	0	0
15 Erie	26	11	6	4	1	4	90	60	265	4	4	0
16 Essex	17	3	2	9	2	1	3	15	151	0	0	0
17 Franklin	19	0	5	13	0	1	0	6	96	0	1	1
18 Fulton	9	1	0	1	5	2	14	0	40	0	0	0
19 Genesee	14	4	6	1	3	0	20	12	120	2	4	0
20 Greene	9	2	2	4	1	0	10	11	39	1	0	0
21 Hamilton	11	2	1	5	3	0	5	1	19	0	0	0

Source: Data extracted by Consultant from data collected by New York State during National Survey (1968)

Table 12-3
(continued)

County	Number of Land Disposal Sites	Remaining Life No. of Sites 0-5 Years	Remaining Life No. of Sites 6-10 Years	Remaining Life No. of Sites >10 Years	Remaining Life Unknown No. of Sites Population Served < 5,000	Remaining Life Unknown No. of Sites Population Served ≥ 5,000	Land Disposal Area Acres 0-5 Years	Land Disposal Area Acres 6-10 Years	Land Disposal Area Acres >10 Years	Land Disposal Area Unknown No. of Sites 0-5 Years	Land Disposal Area Unknown No. of Sites 6-10 Years	Land Disposal Area Unknown No. of Sites >10 Years
22 Herkimer	14	4	4	2	4	0	7	43	56	1	1	0
23 Jefferson	24	7	3	14	0	0	8	9	482	3	1	3
24 Kings	1	1	0	0	0	0	297	0	0	0	0	0
25 Lewis	13	1	1	10	1	0	1	2	37	0	0	0
26 Livingston	19	11	3	5	0	0	27	6	68	1	0	0
27 Madison	17	3	2	10	2	0	9	10	97	0	0	1
28 Monroe	23	7	3	7	3	3	203	21	160	0	0	1
29 Montgomery	11	5	1	0	3	2	10	1	0	0	0	0
30 Nassau	8	7	0	1	0	0	311	0	20	1	0	0
31 New York	0	0	0	0	0	0	0	0	0	0	0	0
32 Niagara	8	5	1	1	0	1	77	0	29	0	1	0
33 Oneida	31	6	6	9	8	2	263	526	105	0	0	2
34 Onondaga	19	4	1	12	0	2	30	0	75	2	1	11
35 Ontario	12	5	3	4	0	0	68	55	74	0	0	0
36 Orange	28	10	4	14	0	0	54	28	608	0	0	0
37 Orleans	16	12	0	4	0	0	87	0	35	3	0	3
38 Oswego	20	2	3	13	1	1	50	5	102	0	1	1
39 Otsego	16	10	1	0	5	0	62	4	0	0	0	0
40 Putnam	6	3	1	2	0	0	22	10	514	1	0	0
41 Queens	3	0	2	1	0	0	0	323	35	0	0	0
42 Rensselaer	14	1	4	8	1	0	11	95	123	0	0	1

Table 12-3
(continued)

County	Number of Land Disposal Sites	Remaining Life No. of Sites			Remaining Life Unknown No. of Sites		Land Disposal Area Acres			Land Disposal Area Unknown No. of Sites		
		0-5 Years	6-10 Years	>10 Years	Population Served < 5,000	Population Served ≥ 5,000	0-5 Years	6-10 Years	>10 Years	0-5 Years	6-10 Years	>10 Years
43 Richmond	3	0	2	1	0	0	0	2,166	180	0	0	0
44 Rockland	4	2	1	0	0	1	44	50	0	0	0	0
45 St. Lawrence	39	2	4	19	14	0	0	14	512	2	1	14
46 Saratoga	19	8	4	6	1	0	159	116	333	0	0	0
47 Schenectady	5	2	1	2	0	0	5	10	65	1	0	0
48 Schoharie	10	1	2	1	6	0	5	15	8	0	0	0
49 Schuyler	3	1	0	2	0	0	15	0	50	0	0	0
50 Seneca	10	6	1	3	0	0	6	2	267	0	0	0
51 Steuben	19	12	4	3	0	0	27	60	115	0	0	0
52 Suffolk	26	15	2	6	2	1	302	61	161	0	0	1
53 Sullivan	22	4	3	15	0	0	11	13	350	0	0	0
54 Tioga	5	2	0	1	1	1	12	0	6	0	0	0
55 Tompkins	8	3	3	2	0	0	52	10	20	0	2	1
56 Ulster	20	2	5	13	0	0	8	74	547	0	0	0
57 Warren	12	6	0	5	1	0	27	0	76	0	0	0
58 Washington	14	1	2	11	0	0	1	38	389	0	0	0
59 Wayne	13	5	2	5	0	1	47	10	145	0	0	0
60 Westchester	19	1	0	0	4	14	40	0	0	0	0	0
61 Wyoming	14	4	2	8	0	0	4	3	125	0	0	0
62 Yates	8	3	4	1	0	0	7	32	23	0	0	0
State Totals	921	261	124	288	188	60	2,891	4,062	7,627	34	22	40

Table 12-4

County-wide Incinerator Data

County	Number of Incinerators	Total Population Served	Weighted Distance to Population Center[1] (miles)	Average Age[1] (years)	Total Rated Capacity (Tons/Day)	Equivalent Operating Rate[2] (Tons/Day)
01 Albany	2	15,000[3]	0.4	21.6	96[4]	23
03 Bronx	1	31,000	4.0	35.0	750	423
08 Chemung	1	13,000	3.0	40.0	80	119
14 Dutchess	1	14,000	1.0	6.0	300	420
15 Erie	5	480,000	4.6	21.9	1,055	1,200[5,6]
17 Franklin	1	4,000	1.0	39.0	88[7]	88
22 Herkimer	2	13,000	1.0	30.1	55	64
24 Kings	4	518,000	3.2	9.7	4,000	3,120
28 Monroe	3	317,000	2.4	20.3	1,100	819
29 Montgomery	3	23,000	1.9	10.9	170[8]	184[8]
30 Nassau	13	1,126,000	6.5	9.2	4,325	3,603
31 New York	4	200,000	1.5	23.0	3,160	2,326
32 Niagara	2	57,000	1.0	12.3	340	287[6]
33 Oneida	1	3,000	1.0	25.0	83[7]	83
36 Orange	2	59,000	1.7	17.7[4]	290[4]	546[5]
40 Putnam	1	5,000	5.0	21.0	40	40
41 Queens	2	123,000	4.1	17.4	1,300	981
44 Rockland	1	55,000	15.0	4.0	300	140
46 Saratoga	1	6,000	1.0	28.0	27	46
48 Schoharie	1	3,000[4]	2.0	30.0	24[4]	6[4]
51 Steuben	1	17,000[4]	0.3	21.0	72	109
52 Suffolk	11	161,000[4]	4.6[4]	12.2	1,744[7]	2,211
53 Sullivan	1	2,000	1.0	20.0	30	34
60 Westchester	13	544,000	4.7	19.1	2,895	2,327
State Totals	77	3,789,000	4.8	15.4	22,324	19,199

[1] Based on population served.
[2] Based on extending the present operating rate to a 24 hour/day, 7 day/week operation.
[3] Data in *Facility Description Report*, as corrected by New York State Department of Health.
[4] Data void in *Facility Description Report* supplemented by data from New York State Department of Health.
[5] Operating rate not given for one incinerator; calculated from estimated tons received yearly.
[6] Operating rate not given for one incinerator and could not be calculated from available data; assumed to be equal to rated capacity.
[7] Rated capacity not given for one or more incinerators; assumed to be equal to operating rate.
[8] Rated capacity and operating capacity not given for one incinerator; neither one could be calculated from available data.

Source: Data extracted by Consultant from data collected by New York State during National Survey (1968).

Table 12-5

Environmental Aspects of Incinerators

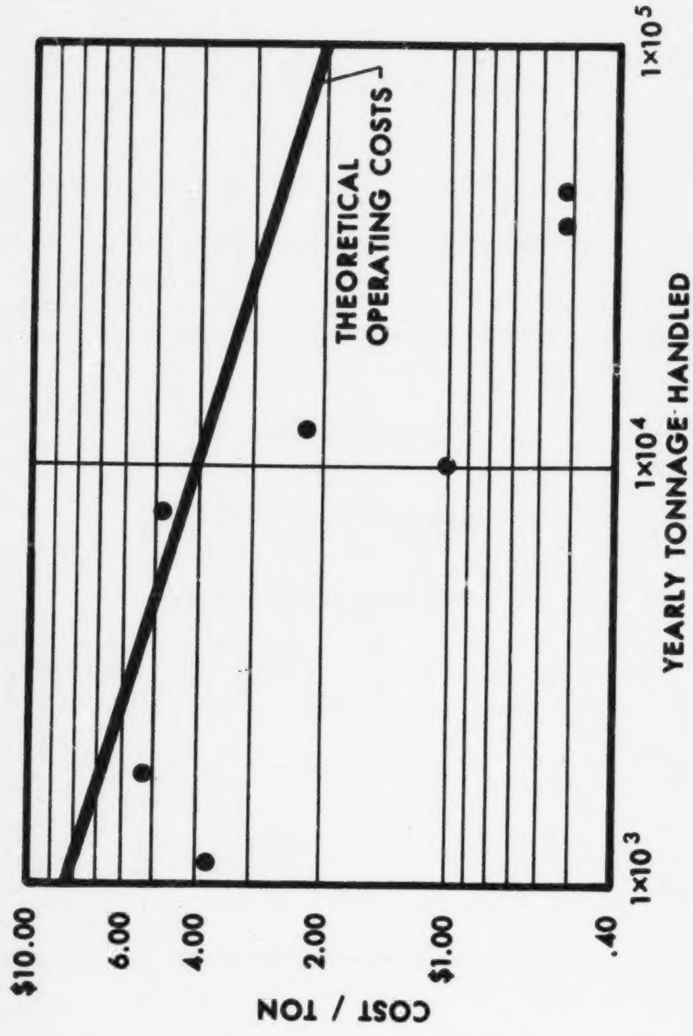
County	Number of Incinerators	Unsightly Incinerators	Incinerators with Problems[1] and No Control Programs	Number of Incinerators with Stack Emission Control Equipment					Number of Incinerators with Satisfactory Performance of All Control Equipment	Number of Incinerators with Observable Plume
				Dry	Water	Mechanical	Electrical	Other		
Albany	2	1	0	0	0	0	0	2	2	0
Bronx	1	0	1	1	0	0	0	0	0	1
Chemung	1	1	1	0	0	0	0	0	----	1
Dutchess	1	1	1	0	1	0	0	0	1	1
Erie	5	0	0	0	0	1	0	0	0	3
Franklin	1	1	0	0	0	0	0	0	----	1
Herkimer	2	0	2	1	0	0	0	0	0	2
Kings	4	0	4	4	0	0	0	0	0	4
Monroe	3	0	0	3^2	1^2	0	0	0	0^3	3
Montgomery	3	2	0	0	0	0	0	0	----	3
Nassau	13	2	7	2	8^2	3^2	0	1	11	12
New York	4	0	4	3	0	1	0	0	0	4
Niagara	2	0	0	0	0	0	0	0	----	0
Oneida	1	0	0	0	0	0	0	0	----	1^4
Orange	2	0	1	0	1	0	0	0	1	2
Putnam	1	0	0	0	0	0	0	0	----	1
Queens	2	0	2	2	0	0	0	0	0	2
Rockland	1	0	0	0	0	0	0	0	----	1
Saratoga	1	0	0	0	0	0	0	1	0	1
Schoharie	1	0	0	0	0	0	0	0	----	1
Steuben	1	0	1	1	0	0	0	0	1	1
Suffolk	11	1	6	2	3^2	3^2	0	1	1	8
Sullivan	1	0	0	0	0	0	0	0	----	1
Westchester	13	6	1	2	8	1	0	2	2^3	7
TOTALS	77	15	31	21	22	9	0	7	19	61

[1] Problems considered are rodents, flies, birds, dust, odors, and wastewater.
[2] One or more incinerators have two types of emission control equipment.
[3] Performance not reported for one or more incinerators, assumed unsatisfactory.
[4] Visibility of plume not reported, assumed observable.

Source: Data extracted by Consultant from data collected by New York State during National Survey (1968).

EXISTING LANDFILLS: OPERATING COSTS VS. YEARLY TONNAGE HANDLED

FIGURE 12 - 1



SOURCE FOR THEORETICAL OPERATING COSTS:
J.M. BELL, "Sanitary Landfills" Facts For Allis – Chalmers Top Salesmen.
Date: April, 1968

CHAPTER THIRTEEN

MUNICIPAL WASTES

For the purposes of discussion, municipal wastes are those wastes attributable to non-manufacturing activities of population groupings, and include: residential wastes, commercial wastes, institutional wastes, demolition and construction debris, and street sweepings.

DATA TYPES AND SOURCES

The State-wide survey was designed to provide the following information:

1. For each land disposal site and incinerator:
    a. Quantity of solid waste received and whether or not this was weighed or estimated.
    b. Percentage breakdown of this waste by weight into household, commercial, institutional, agricultural, industrial, and incinerator residue categories.
    c. Each community served and the population served within that community.
    d. Types of waste rejected.
2. For basic communities:
    a. Quantities of waste collected for twelve categories, e.g. demolition and construction debris.
    b. Number of garbage grinders and household incinerators and whether or not backyard burning is permitted and practiced.

3. For industrial and agricultural firms:

    a. Description and quantity of waste generated.

    b. Percentage (by volume) of waste disposed of on-site.

It was decided to combine commercial, household, and institutional wastes under the one category of municipal wastes because it was difficult to differentiate the three in the data. Many communities in the *Community Description Report* included commercial and household wastes in the category of combined waste. The percentage breakdown in the *Land Disposal and Facility Investigation Reports* for commercial, household, and institutional waste is believed to be inaccurate because:

1. Unless different collection vehicles were used for commercial and household wastes, it could sometimes be difficult at the site to distinguish between the two types.

2. Some sites reported the total wastes received from a municipality as being 100 percent household wastes, which in most cases is not true.

3. The breakdown of wastes was estimated to the nearest 10 percent (to indicate the receipt of some institutional or commercial waste, even though very slight, some sites may have reported the minimum of 10 percent).

Also included under the category of municipal wastes are demolition and construction debris, street sweepings, and park refuse. Abandoned vehicles and water and wastewater treatment sludges were excluded.

Very few land disposal sites or communities reported quantities received, and almost all who did based their information on estimates rather than on actual weighings. Most incinerators reported this information; however, not all of this could be utilized, as many communities served by incinerators were also served by land disposal sites which did not report waste quantities received; thus, the data could not be correlated.

PER CAPITA MUNICIPAL WASTE COLLECTION

For data that could be correlated to a specific population, the total waste quantity received was multiplied by the fraction of commercial plus household and institutional waste. This result was divided by the population served to obtain a collection rate in pounds per capita per day. Oftentimes, this result had to be correlated with collection rates calculated for other incinerators and land disposal sites serving the same community to determine a representative value. If a land disposal site or incinerator served two or more communities, any collection rate obtained was assigned only to the major community served, unless there were two or more prominent communities being served. Likewise, collection rates were obtained from the *Community Description Report* by dividing the quantity of municipal waste collected by the community population. Although many land disposal sites and incinerators reject significant municipal wastes such as garbage, bulky appliances, and construction debris, no effort was made to account for this in the reports, and consequently the collection rates determined for these facilities are expected to be lower.

There are other possible data limitations. Even though the quantity of demolition and construction wastes can be significant, there was no specific category for reporting these wastes in the *Land Disposal Site Investigation Report* and the *Facility Investigation Report*. It is assumed that they were included under the category of household or commercial wastes and not under the category of industrial wastes (many communities which could be assumed to have demolition and construction wastes were reported to have only household and commercial wastes). Another possible limitation is that some of the larger communities are served by more than one facility; the percent population reported to be served by each of these facilities is only an estimate, the accuracy of which estimate is questionable in many instances. Finally, some estimates of the quantities of wastes received were reported in cubic yards without identifying the degree of compaction, if any, in this estimate. A density of 365 pounds per cubic yard was selected as a reasonable value for those estimates reported in cubic yards.

Per capita collection rates were determined in the preceding manner for approximately 200 different communities with populations greater than 5,000. Approximately 50 of these rates appear to be more valid than the others because they were based on actual weighings, they involved incinerator data (an estimate of waste received at an incinerator tends to be more accurate than an estimate of waste received at a land disposal site), or they were for communities with somewhat equal results reported both in the *Community Description Report* and the *Land Disposal Site Investigation Report* (these reports are on somewhat different bases).

As previously discussed, solid waste production depends upon the make-up of the community or area being considered. The quantity of municipal waste collected can be expected to depend in general on population and on population density. Although there is little substantiating data, the following observations indicate this dependence:

1. The more densely populated municipalities are able to offer better municipal services, such as increased frequency of collection of refuse. There is a tendency of households both to generate larger

amounts of wastes with increased frequency of refuse collection and also to rely less on on-site disposal such as backyard burning.

2. The more densely populated urban areas are also able to support more institutional and commercial activity per capita, resulting in an increased per capita production of municipal waste. Regionalized shopping may also add to this.

3. Urban renewal, a major source of demolition and construction debris, is usually more extensive in the larger urban centers than in the more rural communities.

For these reasons, efforts were made to relate per capita collection with population and population density. The approximately 200 collection rates obtained from the results of the State-wide survey were grouped in three levels of population density for four ranges of population (twelve separate groupings). Probability graphs made of the groupings are extremely fragmented, indicating that some of the data are invalid or at least that factors other than population and density are involved. The 50 percent probability values as read from these graphs are shown in Table 13-1. The values for densities less than 4,000 people per square mile are based on a substantial majority of the 200 data points and seem to be most reasonable.

Describing per capita collection by a continuous mathematical relationship is an alternative to the use of discrete values for various population and density groupings. Little correlation could be made between population and per capita collection; however, some apparently reasonable relationships were identified between density and per capita collection. Figure 13-1 is a graph of density versus the collection rates selected to be more valid through the criteria discussed previously in this chapter. The general trend is for per capita collection to increase up to a certain density and then decrease. The apparent range for this transition is around 8,000 to 10,000 people per square mile, which is also the density range generally marking the transition from single-family dwelling communities to multi-family dwelling communities. The multi-family dwelling units have less lawn and garden cuttings, tend to operate their own incinerators, and are generally occupied by families with lower income (a factor found in the New York City study (1) to be directly proportional to refuse production). Also, the larger stores in the urban areas tend to practice more salvage of paperboard and other similar wastes than do the smaller stores associated with the less densely populated areas.

A non-linear approximation of the selected values of per capita waste collection versus population density (in the range of 500-12,000 people per square mile) can be expressed by the functional:

$$u = 1.54 \log D - 0.68$$

where: u = per capita waste collection rate, in lbs/capita/day

D = population density, in people/square mile

The point of transition from increasing per capita collection rate to decreasing per capita collection rate could not be defined due to the lack of data; however, it seems reasonable to use a factor of 5.6 lbs/capita/day for all cities with densities greater than 12,000 people per square mile. For densities less than 500 people per square mile, a factor of 3.4 lbs/capita/day seems reasonable.

In the calculation of solid waste quantities in the current study, each city and village with a population of 10,000 or more was treated individually, while all the smaller cities and villages in a given county were grouped together as a county remainder. The previously-described logarithmic relationship was used to calculate the per capita waste collection rate (and the solid waste quantities) for each larger (≥10,000) city or village except New York City. However, the relationship was not applicable to New York City or to the county remainders, and per capita collection rates specific to these two situations had to be determined by other means. Several approaches were used for county remainders. For those counties where solid waste planning studies had been conducted, a county remainder collection rate was usually determined from information generated in the studies. In other counties, the county remainder rate was determined directly from the results of the State-wide survey if all facilities in the county had reported on the solid wastes received. In still other counties, the waste collection rate was developed by assuming that the population density of each community in the county remainder was less than 4,000 people per square mile and then selecting a representative average rate based on the information in Table 13-1. The county remainder collection rates are listed in Table 13-2.

WASTE COLLECTION RATE TRENDS

Practically every study and all historic data indicate that per capita solid waste quantities will increase in the future. A good indicator of this is the fact that the rate of increase of the Gross National Product (value of goods and services) has been greater than the rate of increase of population. Also of significance are the general opinions that effective collection of waste is increasing at a higher rate than is waste generation and that packaging with disposable containers will increase.

Many studies have reported expected rates of increase varying from 0.5 percent to 4.0 percent per year; some are for all wastes, while others are only for residential wastes. A few studies have generated some apparently valid rates of increase by relying on historical data. One of these studies by the APWA (2) indicated that normal (non-bulky) commercial and residential per capita wastes will increase at a rate of 1.55 percent per year. By averaging historical data obtained from several communities across the nation which had maintained better than average data, a 1966 study (3) determined that the per capita quantity of collected municipal wastes has increased at a rate of 2.5 percent per year. New York City (4) has maintained sufficient records for a long enough time to be able to project an 8 percent per year increase in per capita values for bulky residential refuse and a 4-1/2 percent per year increase in per capita values for bulky commercial refuse. Based on the APWA and New York City projections and representative weighings of bulky and non-bulky wastes, as reported in a well-prepared study (4) for a New York county, per capita municipal waste quantities will increase at a rate of around 2 percent per year for "low projection" populations and over 3 percent per year for "high projection" populations.

These reported rates of increase are applicable to per capita collection rates determined in this study because the basic data are waste collection data rather than waste production data. The actual rate of change of per capita values for specific communities will depend on such factors as:

1. The collection of waste is expected to improve in effectiveness. This increase in waste collected should be more significant in the low-density areas than in the high-density cities.

2. Increasingly stringent air quality regulations could, in the near future, preclude the economic use of apartment incinerators and prohibit backyard burning of refuse in certain areas.

3. Communities, presently with low and medium density populations, can expect increased land development and construction, with attendant wastes. As less and less land remains undeveloped, construction waste will tend to be replaced by garden and lawn cuttings. This should continue for some years. Older cities should continually be the subject of increased urban renewal with its substantial wastes.

4. Commercial activities may decline in many high-density communities if the trend of regional and suburban shopping centers continues.

Valid data are not available to develop a mathematical relationship between such factors and the specific rates of increase; however, it seems reasonable to assume that per capita collected quantities of municipal wastes will increase at a rate from 2 percent to 3 percent per year, with greater increases in the suburbs and low-density areas than in the cities. Consequently, for this study the per capita collection rates are estimated to increase at a rate of 2 percent per year for cities and villages greater than 10,000 population, and 3 percent per year for county remainders. New York City will be projected at 3 percent per year, to reflect the increases from urban renewal and to reflect the higher actual data indicated earlier.

POPULATION AND PROJECTIONS

It is important in this study to identify geographical distribution of solid wastes. Since a correlation between population density and solid waste quantities was established, the application of density mapping was explored. The Harvard SYMAP computer mapping routine (Version 3) was evaluated and determined applicable to this study. Since this is the first application of a rather sophisticated mathematical tool in solid waste planning, data had to be developed specifically for this study.

Chapter Five presented a discussion of current and future population and density levels by Economic Areas and by counties within the State. These same basic population data were used in the determination of current and projected municipal wastes. Population projections for counties and all Minor Civil Divisions for the five-year intervals from 1965 to 2015, inclusive, were obtained from the New York State Office of Planning Coordination. County land area in square miles was taken from the 1968 City-County Data Book, published by the U. S. Bureau of Census. Land area and density for principal cities and villages of 10,000 or more population were obtained from the New York State Department of Health, 1968 Solid Waste Inventory Data, Basic Community Description Report. Because the computer mapping routine had a limitation on the number of data entries, only cities and villages with populations of 10,000 or more were treated individually; the smaller communities were grouped into county remainders. The cities and villages account for approximately two thirds of the State population, and the county remainders account for the other third.

Following the procedure prescribed by the derivation of relevant per capita waste collection rates, the population, land area, and density for cities and villages in excess of 10,000 population were recorded. Population, land area, and density for county remainders were derived by simple subtraction and division. Checks were made to ensure consistency of total county populations. These figures were derived and recorded for the selected target years of 1965, 1970, 1975, 1985, and 1995.

For computer mapping purposes, each city and village was assigned a row-column coordinate which most nearly represented its actual geographic position. For county remainders, a moment centroid technique was used to determine the geographic center of remaining population and the corresponding row-column coordinate. For total County information, the same moment centroid technique was used to determine center of total population. Population Density Maps 1, 2, and 3, previously discussed in Chapter Five, are based on the total county population centers.

EXISTING AND PROJECTED WASTES

Two computer based procedures were used to determine the existing and projected quantities of solid waste. For cities and villages with population densities between 500 and 12,000 people per square mile, the equation described earlier in this chapter was used to compute an unadjusted per capita waste collection rate. For cities and villages with population densities of less than 500 or more than 12,000 people per square mile, 3.4 and 5.6 lbs/capita/day, respectively, were used as the unadjusted waste collection rate. The rate was then adjusted for growth by applying a 2 percent compound interest function for every year since 1968 (the base year for the unadjusted rate). The resultant adjusted collection rate was then multiplied by the city or village population of the desired target year to yield total waste collected in pounds per day for that year. This was then converted to tons per year of total waste for that municipality.

Values of the remainder of counties were derived by adjusting the predetermined county remainder specific waste collection factor for 1968 using a compound interest function with a rate of increase of 3 percent per year for every year since 1968. The resultant adjusted rate was then multiplied by the county remainder population in the desired target year to yield total waste collected in pounds per day for that year, which was then converted to tons per year of total waste.

The results of these two operations were added to yield total county waste collected in tons per year. This two-step procedure was found to be more reliable than an operation which would directly determine the total municipal waste collected in a county with no intermediate steps. Table 13-3 illustrates the results of this two-step procedure for a selected county. Although computer maps were executed both for municipality with remainder of county, and for total county waste data, only the latter were used for purposes of first-round analysis. To obtain a useful differentiation on the maps, total county wastes for the target year were divided by total county land area yielding collected municipal wastes per square mile for each target year.

Total collected municipal wastes for each county and the overall State total are presented as tons per year in Table 13-4 and as tons per year per square mile on Maps 9 through 11. As shown in Table 13-4, total collected municipal wastes for the state of New York were determined to be about 13,640,000 tons per year in 1965. Projections indicated a total of approximately 14,475,000 tons per year by 1970 and finally 38,282,000 tons per year by 1995, or nearly three times the amount of municipal waste collected in 1965. On a county basis, in 1965 Kings County contributed the highest, and Hamilton County the lowest total tonnages of collected municipal wastes. Five counties contributed over one million tons of collected waste in 1965: four New York City counties and Nassau County, immediately adjacent. The same situation is projected to hold true in 1970; and in that year, Kings County is projected to contribute slightly more than two million tons of collected municipal waste, the first county to reach that level. By 1975, seven counties (the five previously mentioned plus Erie and Suffolk Counties) are projected to contribute more than one million tons of collected municipal waste annually. Again, Kings County is projected to contribute over two million tons. The projections for 1995 indicate that ten counties (the previous seven plus Monroe, Onondaga, and Westchester) will contribute over one million tons each of collected municipal waste that year. Of the ten, Monroe and Onondaga were projected to contribute between one and two million tons, while the remaining eight contribute over two million tons each. Suffolk County is projected to contribute the highest amount (slightly more than five million tons) an increase of some 600 percent during the 30-year interval from 1965.

The density of waste in collected tons per square mile, presented on Maps 9 through 11, illustrates the relative intensity of waste by area and buildup with time. The overall pattern depicted is one of a major increase in municipal waste collected in those urbanizing counties which make up the Hudson River-Mohawk Valley State development corridor. Maps for succeeding years illustrate the general growth expected and imply the extension of major municipal waste sources out from existing central cities. Information from these and succeeding maps, influenced by other data, is used in the discussion and delineation of tentative service areas presented in Chapter Nineteen. Chapters Fourteen and Fifteen will present the definition and derivation of industrial and agricultural wastes, also important in the delineation of tentative service areas.

REFERENCES

1. "Population and Refuse Projections", Study for New York City Department of Sanitation, performed by Foster D. Snell, Inc., New York, New York (1968).

2. *Refuse Collection Practices,* American Public Works Association, (1969).

3. "Technical - Economic Study of Solid Waste Disposal Needs and Practices: Volume 1 - Municipal Inventory", Combustion Engineering, Inc., (1967).

4. "An Action Plan for Solid Wastes Disposal in Suffolk County, New York: Volume 2 - Detailed Report", John J. Baffa, Consulting Engineers.

Table 13-1

Municipal Solid Waste Collection Rates[1] lbs/capita/day

Population	Waste Collection Rates by Population Density Ranges		
	0-3,999/sq.mi.	4,000-6,999/sq.mi.	7,000+/sq.mi.
0-4,999	3.3	-----	-----
5,000-19,999	3.6	5.0	4.6
20,000-99,999	4.1	4.1	4.6
100,000	4.6	5.1	5.6

---

[1] Consultant's Analysis.

Table 13-2

Municipal Solid Waste
County Remainder Waste Collection Rates[1]
lbs/capita/day

Albany	3.9
Allegany	3.3
Bronx	3.9[3]
Broome	3.8
Cattaraugus	3.3
Cayuga	3.3
Chautauqua	3.3
Chemung	4.7[2]
Chenango	3.4
Clinton	3.5
Columbia	3.0[2]
Cortland	3.3
Delaware	3.3
Dutchess	3.7
Erie	3.8
Essex	3.3
Franklin	3.4
Fulton	3.3
Genesee	3.3
Greene	3.3
Hamilton	3.3
Herkimer	3.4
Jefferson	3.3
Kings	3.9[3]
Lewis	3.3
Livingston	3.3
Madison	3.4
Monroe	3.9
Montgomery	3.3
Nassau	4.4
New York	3.9[3]
Niagara	3.5
Oneida	3.5
Onondaga	3.9
Ontario	3.4
Orange	3.7
Orleans	3.3
Oswego	3.4
Otsego	2.5[2]
Putnam	3.5
Queens	3.9[3]
Rensselaer	3.5
Richmond	3.9
Rockland	4.0
St. Lawrence	3.4
Saratoga	3.4
Schenactady	4.0
Schoharie	3.3
Schuyler	3.3
Seneca	3.4
Steuben	3.4
Suffolk	4.4[3]
Sullivan	3.4
Tioga	3.5
Tompkins	3.5
Ulster	3.5
Warren	3.5
Washington	3.4
Wayne	3.4
Westchester	3.8
Wyoming	3.3
Yates	3.3

[1] Consultant's Analysis.

[2] Determined directly from reported results of statewide survey.

[3] Determined from county/city studies.

Table 13-3

Illustrative Table Showing Principal City/Village, County Remainder, and Total County Wastes for Westchester County - 1970[1]

	Population	Municipal Waste tons/year
Peekskill	19,491	15,957
Ossining	18,662	16,030
Tarrytown	12,600	11,448
White Plains	56,362	48,184
Port Chester	24,960	22,986
Rye	16,434	12,710
Scarsdale	20,480	16,077
Mamaroneck	17,673	15,009
Mount Vernon	76,010	70,849
New Rochelle	76,812	67,205
Yonkers	190,634	174,690
County Remainder	416,736	305,461
Total County	946,854	776,534

[1] Based on consultant's analysis of information from the Office of Planning Coordination and the 1968 National Solid Waste Survey.

Table 13-4

Existing and Future Total Collected Municipal Wastes by County[1] (1,000 Tons/Year)

County	Years 1965	1970	1975	1985	1995
Albany	234	245	297	444	576
Allegany	28	29	35	50	71
Bronx	1,123	1,169	1,373	1,384	2,581
Broome	177	182	218	319	478
Cattaraugus	55	55	63	84	115
Cayuga	55	55	63	86	117
Chautauqua	105	107	124	170	238
Chemung	91	95	114	169	248
Chenango	29	31	37	55	81
Clinton	57	60	72	107	159
Columbia	32	33	33	55	79
Cortland	32	33	39	55	82
Delaware	27	26	30	42	38
Dutchess	160	182	237	418	755
Erie	290	922	1,076	1,519	2,162
Essex	22	22	26	57	52
Franklin	29	29	34	49	73
Fulton	38	37	41	53	71
Genesee	39	40	48	70	104
Greene	20	21	25	36	53
Hamilton	2	2	3	4	5
Herkimer	45	47	55	79	111
Jefferson	61	60	67	87	119
Kings	1,995	2,049	2,352	3,104	4,104
Lewis	14	15	17	23	32
Livingston	29	31	38	56	87
Madison	36	39	50	82	134
Monroe	533	569	688	1,022	1,522
Montgomery	41	40	44	55	70
Nassau	1,187	1,225	1,446	2,058	2,821
New York	1,153	1,158	1,313	1,699	2,197
Niagara	194	196	226	324	462
Oneida	205	213	253	388	537
Onondaga	376	398	482	723	1,091
Ontario	50	52	63	93	136
Orange	170	203	279	518	927

---

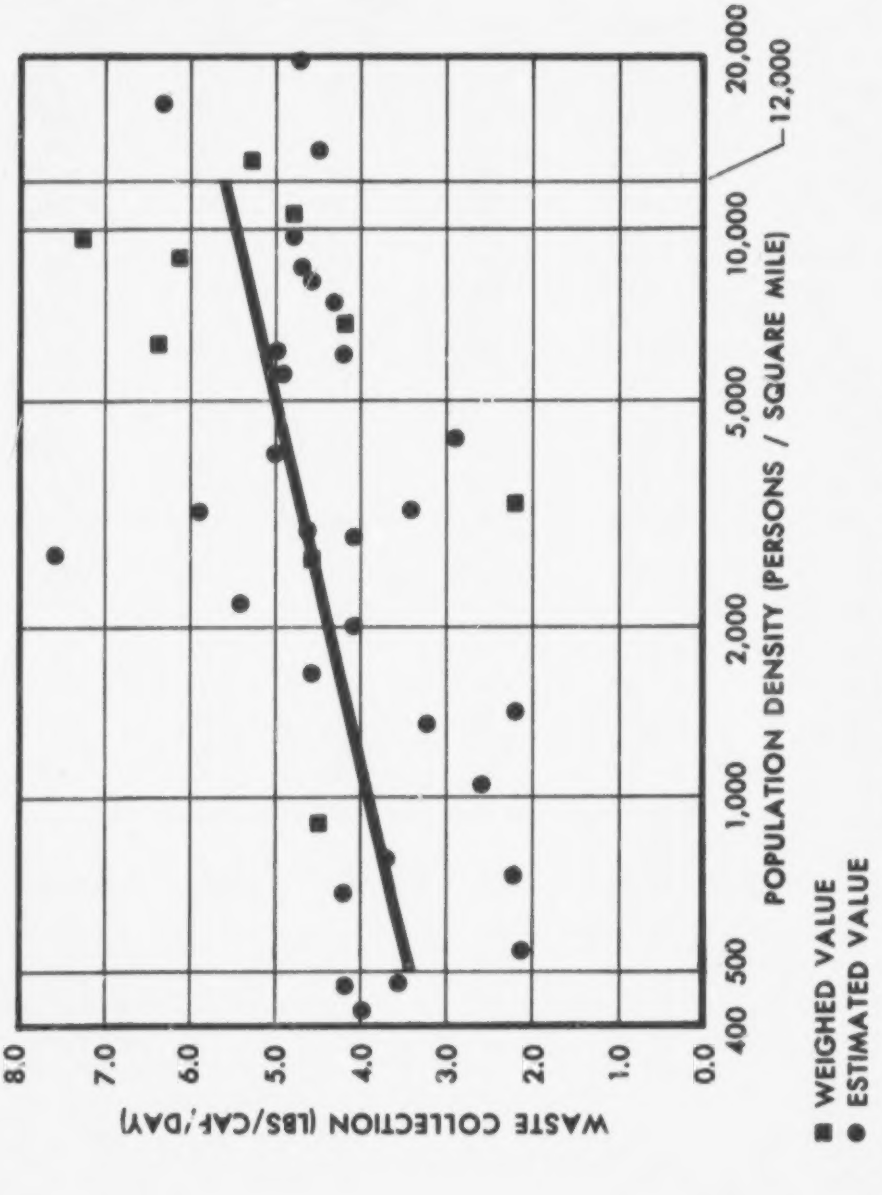
[1] Consultant's Analysis.

Table 13-4
(continued)

County	Years 1965	1970	1975	1985	1995
Orleans	22	24	29	44	63
Oswego	65	69	85	133	206
Otsego	29	29	35	49	71
Putnam	27	35	52	104	204
Queens	1,435	1,539	1,848	2,617	3,624
Rensselaer	119	124	148	216	322
Richmond	191	222	291	506	858
Rockland	137	178	237	425	745
St. Lawrence	80	85	104	158	241
Saratoga	63	69	87	139	223
Schenectady	133	135	159	228	327
Schoharie	14	14	17	23	32
Schuyler	9	9	11	17	24
Seneca	21	22	26	38	54
Steuben	71	72	84	116	160
Suffolk	759	990	1,356	2,667	5,270
Sullivan	30	32	38	54	77
Tioga	28	31	39	64	103
Tompkins	54	59	73	112	177
Ulster	94	104	128	197	307
Warren	34	36	42	61	89
Washington	31	31	37	52	78
Wayne	49	53	65	104	167
Westchester	716	777	956	1,447	2,141
Wyoming	22	22	26	37	54
Yates	11	11	14	19	28
New York State	13,639	14,475	17,382	25,681	38,282

UNIT MUNICIPAL WASTE COLLECTION
VS POPULATION DENSITY

FIGURE 13 - 1



SOURCE: NEW YORK STATE INVENTORY DATA, 1967-1968

CHAPTER FOURTEEN

INDUSTRIAL WASTES

Industrial wastes include an almost unbelievable conglomeration of materials which range from paper used in product packaging, to complex chemicals, both solids and liquids. Very little information is available on these wastes, and frequently the industry which produces the waste has no knowledge of its impact on conventional solid waste disposal practices.

The National Solid Wastes Survey was only peripherally concerned with identification of industrial wastes. Although the survey results provide an estimate of the percentage of industrial waste in the total waste received, the information does not permit definition of industrial waste characteristics. A separate survey conducted by New York State asked for gross tons of waste produced per year, along with certain basic information such as number of employees and square feet of manufacturing area.

This survey was conducted through questionnaires with approximately 50 percent response. However, very little information was reported on solid waste quantities, no information was obtained on waste characteristics, and much of the reported information is questionable. For example, one chemical company with 22 employees reported a waste production of 10,000 tons per day. When compared to the approximately 300 tons per day from the largest chemical plant in the United States, employing over 12,000 people, the reported item is subject to considerable doubt.

In the same manner as with municipal wastes, it was the task of this study to analyze available data, determine its sufficiency, make projections of waste quantities into the future, and define further data needs. The last element is discussed in subsequent chapters, but discussion of the first three follows in this chapter.

APPROACH TO WASTE QUANTITY DETERMINATION

As stated above, neither quantitative information or delineation of waste characteristics was available on a reliable basis from any of the survey data. It was then necessary to devise some means of forecasting industrial waste quantities in a manner sufficiently accurate for this study.

If a methodology similar to that used for municipal wastes is to be used (multiplying the number of projected production units by the projected unit quantities), a relationship must be established between units of production and wastes. Previous studies (1) pertaining to water-borne wastes from industries, have shown a reasonably consistent relationship between wastes discharged and tons of products. While it is reasonable to assume that a similar relationship would exist for solid wastes, no known studies have been conducted which relate production and solid waste. Furthermore, obtaining production figures on a regular basis from industrial plants may present serious difficulty.

Another possible relationship is waste quantity per employee. While it is recognized that for an individual manufacturing establishment, specific circumstances could completely distort an "average" condition, it was felt that waste production rates would not vary significantly within industry groups. Also, experience with industrial wastes has shown that when dealing with gross quantities, unit production rates tend to be quite uniform throughout an industry group. Therefore, the waste generation/employee relationship was chosen for projection of industrial solid waste quantities in this study.

UNIT WASTE PRODUCTION

Information available in the literature was explored. Two states have been conducting surveys in the field of industrial solid wastes. California (2) has collected and published some comprehensive waste data for the fruit processing, lumber, chemical, and petroleum industries, and has been able to determine or estimate waste production rates per employee for major SIC (Standard Industrial Classification) Codes. Pennsylvania's industrial survey is currently underway, and some of the available results can be applied to determine approximate breakdown of wastes by type from industry.

The California data were used to approximate the magnitude of industrial solid waste production throughout New York. The quantity of industrial solid waste by county was determined by multiplying projected county employment data from the various *County Business Patterns* by the per employee waste production rates determined from California data.

Many manufacturers, e.g. food processors, have seasonal employment, and California took special care to base waste production for these manufacturers on man-months rather than man-years. The 1967 *County Business Patterns* give the count of employees on the payroll as of March and do not identify seasonal employment. To determine compatible waste production rates, the 1967 California solid waste tonnages for the various SIC Coded industries were divided by the total California employment in the corresponding SIC Coded industries as taken from the 1967 *County Business Patterns.* Since it is reasonable to assume that the ratio of seasonal to March employment is approximately equal for California and New York, California-derived waste production rates per employee, determined in the above manner, can be applied to New York State employment data projected from *County Business Patterns.*

Table 14-1 is a listing of all per employee waste production rates, by SIC Codes, which could be determined from California data. Some of these factors were taken directly from the context of the California report when seasonal or other factors did not seem important, but most were determined by dividing the reported tonnages by the corresponding SIC Coded employment. It is believed that these waste production rates can be applied to New York State to determine plausible county-wide totals for industrial waste production. However, these rates should not be used to determine the quantity of waste generated by a particular industry.

There would be no advantage in applying a waste production rate for a particular SIC Code to New York State if the resulting waste production is insignificant. To check this, the SIC Coded State employment in 1967 was multiplied by the corresponding waste production rates to determine total industrial solid waste in the State. These calculations indicated that major group 19 (Ordnance), industrial groups 285 (Paints and Varnishes) and 291 (Petroleum Refining), and industry 2411 (Lodging) were insignificant waste producers from a volume standpoint. Consequently, waste production rates for these industries and groups were combined with other waste production rates.

These calculations also substantiate the need for more information on wastes produced by the primary metals group. Approximately 40 percent of the total quantity of industrial solid wastes in New York is produced by the primary metals group. Even though the employment breakdown within the primary metals group is about the same for New York and California, as shown in Table 14-2, the preponderance of low unit-waste producing industries within the primary metals group in a particular county or area could drastically distort the magnitude of the industrial waste problem there. The waste production rate for the primary metals group appears to be applicable to New York State as a whole, but insufficient for determining geographical distribution of wastes within the State.

Excluded from the industrial waste category are fruit and vegetable fresh-pack wastes and mining wastes. Although California determined that fresh-pack wastes amount to 1.5 tons per man-month, the lack of New York employment data for this category precluded its inclusion. California did not study mining wastes.

EXISTING AND PROJECTED EMPLOYMENT

To develop industrial waste quantities, employment in each SIC Code must be forecast so that the above values may be used to obtain total wastes generated in the various target years. Existing and projected levels of employment were presented and discussed in Chapter Six by Economic Areas and by counties with regard to absolute and relative growth. The accompanying computer maps (Maps 4, 5, and 6) of industrial employment density were based on total employment by county divided by total county land area for each target year, and represents employees per square mile. One data point was assigned for each county. The location was determined by a moment centroid technique.

The employment data for both the existing and the projected levels were gathered for each of the 62 counties and for the State total from the *County Business Patterns,* First Quarter, U. S. Census, for the years 1962, 1965, and 1967. The information was collected for each of the SIC (Standard Industrial Classification) Codes shown in Table 14-1. These were reduced to the 25 SIC Codes shown in Table 14-3 to coincide with the final waste production rates developed in the preceding analysis. Forecasts[1] for each county for SIC Code groupings were provided by the Department of Commerce of the State of New York.

Using the historic data from 1962, 1965, and 1967, and settingthe base year as 1965, a modified semi-log projection series was run, using the EDA projections as iterative control curves to prevent too great an increase or decrease. Projections were made in five-year increments, beginning with 1965 and extending to 2000 for each final SIC Code (25) for each county (62). Three to five growth curves were developed for each SIC for each county. Several techniques and tests were used to reduce those curves to one final curve for each SIC within each county. Results for the target years 1965, 1970, 1975, 1985, 1995 were recorded for each SIC Code for each county to be used in the waste load derivations, and these were then added to yield total industrial employment in each county for each target year.

---

[1] Originally prepared (with projections through 1975) by Dr. Curtis Harris, of the University of Maryland, for the Economic Development Administration.

EXISTING AND PROJECTED INDUSTRIAL WASTES

In contrast to forecasts of municipal wastes, there is no evidence that unit waste quantities for industrial wastes are growing with time. Therefore, the same waste production rate for each SIC given in Table 14-3 in tons/employee/year was multiplied by the existing and projected employment in that SIC for all target years for each county. The 25 results for each county were added to yield total industrial waste by county in tons per year. The county waste totals were then added to obtain State waste totals for each target year in tons per year. Table 6-3 (Chapter Six) presented total employment for each county for each target year. Table 14-4 contains the total waste tonnages derived for each county for each target year in tons per year and total industrial waste tonnages for the State. Reasonablensss checks were made by using reported figures from New York State county studies and other waste surveys whenever available.

The resultant total industrial wastes for each county were divided by total land area in each county to yield tons/year/square mile. This information was mapped and is shown on Maps 12 through 14. To further the utility of the information, resultant total industrial wastes for each county were combined with total municipal wastes for each county and were divided by total land area. This information is presented on Maps 15 through 17, using the same scaling factor as was used for the maps of municipal wastes. (The maps depicting industrial waste tonnages per square mile alone, use a smaller scaling factor to allow greater differentiation.) On both sets, the obvious pattern is a high intensity in the counties located in and near the principal State development corridors, with a concomitant low density in rural counties and in those containing major park lands such as the Forest preserves.

Some interesting facts come to light when the maps depicting industrial waste density alone are compared with the industrial employment density maps. In certain counties, employment density is high, while waste density is low; in other counties, the reverse is true. This is a function of the relative levels of waste produced from the industries responsible for the high employment. The best example is the electronics industry (SIC 38), with a very small waste production rate (9.12 tons/employee/year). Monroe County has very high employment, principally in this industry, and a high employment density. However, the resultant waste load is relatively small. The ability to identify detailed information of this nature will be significant in the later development of the detailed solid waste plan.

In terms of absolute tons per year, industries in the State of New York generated about 5,100,000 tons of waste in 1965. This was projected to decrease slightly in 1970 because of a major loss in certain high waste-producing industries in several counties. However, by 1985 the total waste tonnage is projected to increase to more than 9 million tons per year. The projection for 1995 indicates a significant increase to a little over 19 million tons per year, almost 400 percent of the quantity produced in 1965. On a county basis, industries in Erie County (a heavily industrialized area) in 1965 generated just over one million tons of waste, a level which will increase steadily through 1995. Total waste in most counties averages less than 50,000 tons per year, and is projected to change only a small amount through 1970 and 1975. From 1965 through 1995, Putnam and Schoharie Counties decrease in their contribution of industrial waste to almost insignificant levels. Hamilton County, with no industry in 1965, picked up some industrial activity in 1967, but the resultant wastes are projected to increase only slightly by 1995.

By 1985, a significant increase in industrial waste generation is projected, with contributions of over one million tons each from Erie and New York (Manhattan) Counties. Eighteen additional counties, all in the major development corridor, are each forecasted to generate in excess of 100,000 tons per year of industrial waste. In 1995, Erie and New York Counties again are projected to generate more than one million tons of waste per year, and twenty-six other counties are projected to generate in excess of 100,000 tons each, and five of these in excess of 500,000 tons.

The major increases and the intensification of industrial waste generation are occurring generally within the same counties which have a high projected level of collected municipal waste. Although a large number of industries do have some internal waste disposal systems, it is expected that an increasing amount of industrial wastes will require public disposal. The combination of these two types of waste and their differences in composition could present problems in collection and ultimate disposal. The future quantity of industrial waste may depend largely on technological changes and on the feasibility of utilizing or marketing by-products. Industrial waste production based on the number of employees will not reflect any trend toward highly automated manufacturing. However, this may be offset by efforts of labor unions to gain shorter working hours. Possibly of significance is the quantity of industrial waste to be disposed of by the industrial concerns on their own sites. An industrial inventory study (3) showed that 55 percent of the solid wastes produced by industry is disposed of on industrial sites, the remaining 45 percent being handled primarily by private contractors and disposed of at either private or municipal facilities. Any decrease or increase in the quantity of waste disposed of in the industrial sector may offset or compound any decrease or increase in quantity of waste produced. More information is needed to determine the long-range potential and effects of materials reuse and recapture in developing service areas and an ultimate disposal plan.

REFERENCES

1. "Cost of Clean Water", FWPCA Publication IW-3.

2. "Status of Solid Waste Management in California", California State Department of Public Health, (September 1968).

3. "Technical - Economic Study of Solid Waste Disposal Needs and Practices: Volume 2 - Industrial Inventory", Combustion Engineering, Inc., (1967).

Table 14-1

Preliminary Industrial Solid Waste Production Rates[1]

SIC Code	Industry	Waste Production Rate (tons/employee/year)
19	Ordnance	0.43
201	Meat Processing	6.2
2033	Cannery	55.6
2037	Frozen Foods	18.3
Other 203	Preserved Foods	12.9
Other 20	Food Processing	5.8
22	Textile Mill Products	0.26
23	Apparel	0.31
2411	Logging	1,930
2421	Sawmills and Planing Mills	162
Other 24	Wood Products	10.3
25	Furniture	0.52
26	Paper and Allied Products	2.0
27	Printing, publishing	0.49
281	Basic Chemicals	10.0*
285	Paints, varnishes	2.25*
Other 28	Chemical and Allied Products	0.5*
291	Petroleum Refining	23.5*
Other 29	Petroleum and Coal Products	10.0*
30	Rubber and Plastic	2.6
31	Leather	0.17
32	Stone, clay	2.4
33	Primary Metals	24
34	Fabricated Metals	1.7
35	Non-electrical Machinery	2.6
36	Electrical Machinery	1.7
37	Transportation Equipment	1.3
38	Professional and Scientific Inst.	0.12
39	Miscellaneous Manufacturing	0.14

[1] Consultant's Analysis.

*Taken directly from California study (1).

Table 14-2

Industrial Solid Wastes
Comparison of Employment in Primary Metals Group[1]

SIC Code	Description	Percentage of 1967 State Employment in SIC 33	
		New York	California
331	Steel Rolling & Finishing	46%	39%
3312	Blast Furnaces & Mills	39%	31%
332	Iron & Steel Foundries	11%	14%
333	Primary Non-Ferrous Metals	3%	1%
334	Secondary Non-Ferrous Metals	3%	2%
335	Non-Ferrous Rolling & Drawing	24%	18%
336	Non-Ferrous Foundries	10%	16%
337	---	0%	0%
338	---	0%	0%
339	N. E. C.	3%	10%

[1] Consultant's Analysis.

Table 14-3

Final Industrial Solid Waste Production Rates[1]

Activity Number	SIC Code	Industry	Waste Production Rate (tons/employee/year)
1	201	Meat Processing	6.2
2	2033	Cannery	55.6
3	2037	Frozen Foods	18.3
4	Other 203	Preserved Foods	12.9
5	Other 20	Food Processing	5.8
6	22	Textile Mill Products	0.26
7	23	Apparel	0.31
8	2421	Sawmills and Planing Mills	162.0
9	Other 24	Wood Products	10.3
10	25	Furniture	0.52
11	26	Paper and Allied Products	2.00
12	27	Printing and Publishing	0.49
13	281	Basic Chemicals	10.00
14	Other 28	Chemical and Allied Products	0.63
15	29	Petroleum	14.8
16	30	Rubber and Plastic	2.6
17	31	Leather	0.17
18	32	Stone, Clay	2.4
19	33	Primary Metals	24
20	34	Fabricated Metals	1.7
21	35	Non-electrical Machinery	2.6
22	36	Electrical Machinery	1.7
23	37	Transportation Equipment	1.3
24	38	Professional and Scientific Inst.	0.12
25	39	Miscellaneous Manufacturing	0.14

---

[1] Consultant's Analysis.

Table 14-4

Total Industrial Wastes by County and State[1]
(1,000 Tons/Year)

County	Years				
	1965	1970	1975	1985	1995
Albany	103	105	113	140	198
Allegany	12	21	30	62	134
Bronx	102	84	74	65	64
Broome	59	79	115	282	749
Cattaraugus	59	25	32	60	124
Cayuga	23	32	48	124	381
Chautauqua	134	142	160	207	281
Chemung	42	50	63	105	188
Chenango	21	9	12	30	102
Clinton	6	4	5	15	83
Columbia	8	6	9	21	56
Cortland	20	22	24	31	42
Delaware	31	27	25	23	22
Dutchess	50	33	26	30	56
Erie	1,030	1,045	1,069	1,153	1,327
Essex	20	2	3	9	24
Franklin	4	6	8	20	47
Fulton	5	4	5	5	7
Genessee	30	38	54	145	656
Greene	5	4	3	4	5
Hamilton		1	1	1	1
Herkimer	61	30	42	90	198
Jefferson	14	16	21	42	99
Kings	480	399	374	398	520
Lewis	3	2	2	2	2
Livingston	10	15	22	57	155
Madison	3	4	6	22	85
Monroe	207	225	267	423	760
Montgomery	13	11	12	18	31
Nassau	298	298	304	352	495
New York	454	548	526	2,430	8,137
Niagara	173	199	249	404	741
Oneida	142	49	62	121	290
Onondaga	236	258	285	359	474
Ontario	23	30	38	70	164
Orange	29	34	40	62	110

---

[1] Consultant's Analysis.

Table 14-4
(continued)

County	Years 1965	 1970	 1975	 1985	 1995
Orleans	25	29	32	42	53
Oswego	38	43	50	72	108
Otsego	3	4	4	5	5
Putnam	2	1	1	1	
Queens	296	287	282	304	369
Rensselaer	18	19	22	32	53
Richmond	72	78	85	103	126
Rockland	13	25	32	52	89
St. Lawrence	107	121	136	171	217
Saratoga	12	13	15	20	26
Schenectady	42	41	40	41	43
Schoharie					
Schuyler	37	1	1	1	1
Seneca	5	6	8	13	24
Steuben	39	43	49	66	95
Suffolk	63	78	98	161	279
Sullivan	16	16	16	16	17
Tioga	4	3	4	4	5
Tompkins	11	13	14	16	20
Ulster	28	31	36	53	94
Warren	52	65	83	138	240
Washington	9	9	9	9	9
Wayne	53	53	54	55	58
Westchester	176	182	193	226	273
Wyoming	10	10	10	11	13
Yates	16	16	16	17	17
New York State	5,086	5,076	5,449	9,041	19,073

CHAPTER FIFTEEN

AGRICULTURAL WASTES

Agricultural wastes include manure from confined animals, harvesting residue and crop spoilage from field crops, trimmings, residue, and spoilage from fruit and nut orchards, and trees lost through disease. Some apparently valid manure production factors were reported in a recently published Cornell University study (1), and the State of California (2) has conducted some extensive surveys and studies to identify waste production from field crops and orchards. Because little information was readily available on agricultural waste production in New York State, it was decided to use the California and Cornell data. Fortunately, practically all the crops grown in New York are grown in California and were reported on.

Table 15-1 lists the categories of agricultural waste producers and the corresponding waste production rates. The extended growing season in California prompted concern that some waste production rates may be based on double cropping, and therefore, cannot be applied to New York State without adjustment. Communication with California officials revealed that this was of little concern as acreage in some area of California is double cropped, but with different crops, e.g. one tract may be used to raise broccoli in the spring and carrots in the summer, but never the same crop both in the summer and spring. Plums and prunes, designated separately as Class 3 and Class 5 waste producers by California, were combined and reported as one crop in the New York State agricultural census. To adjust for this, the two fruits were grouped in Class 4.

Two animal types not reported in either the California or the Cornell study were deemed to be significant waste producers in New York. These were horses and ducks. Duck raising is confined to Suffolk County (8 million ducks slaughtered in 1967). Ducks are considered to produce manure at the same rate as fryers, 6.4 tons/1,000 birds/year. In some counties, horses produce considerable quantities of manure, which may be significant since many of the horses are penned. Horses were considered to produce manure at an annual rate between those of beef cattle and dairy cows, approximately 12 tons/head/year. Sheep are not considered significant waste producers as they are usually pastured. It should be noted that the production rates are for wet manures and that the rates also do not include any straw bedding, which is sometimes used to facilitate removal of manure.

Exclusive of abnormalities such as the advent of a serious tree disease, the quantity of agricultural waste produced per acre or per animal should not vary significantly in the future. Of far more consequence, will be the quantities of waste which can be disposed of on the farm. The harvest residue and crop spoilage from field and row crops do not present a significant disposal problem at this time. However, these wastes are sometimes burned at the farm. This practice may be banned in the future as air quality regulations become increasingly stringent. These wastes may then require serious consideration.

Manure could present a major solid waste disposal problem. The large quantities of manures from confined animals (hog-feeding lots, poultry, penned horses, etc.) are presently being sold as soil conditioners and fertilizers, spread on farm lands, or sold as media for mushroom growing. However, the impact of storm runoff from farms on water quality could be deemed serious, the use of inorganic chemical fertilizers could increase, and a synthetic mushroom soil could be developed. Any of these or other developments could make manure disposal a major problem.

EXISTING AND PROJECTED AGRICULTURAL ACTIVITIES

A brief discussion of general levels of agricultural activity by Economic Areas, and by counties was presented in Chapter Six. The information presented was derived from the existing and projected numbers of penned stock and of acres in the various classes of fruit, nut, field, and row crops, and was prepared as a basis for developing tonnages of agricultural wastes by counties and for the State.

Raw data for agricultural activity were collected for animals, fruit and nut crops, and field and row crops from the Census of Agriculture, U. S. Bureau of the Census, for 1954, 1959, and 1964 for each county. Average annual yields for: 1) fruit and nut crops in pounds or bushels per tree or vine; 2) average pounds of fruit per bushel yield; and 3) average trees or vines per acre in fruit and nut as well as field and row crops, were obtained from the records of the AES at Cornell University and in Washington, D.C., and from the experimental pollenization studies underway in New York.

Reported counts of animals in 1,000's or units of head were recorded directly. Acreages for fruit and nut crops were derived from reported total trees and vines using an average number of trees or vines per acre for each fruit and nut crop. Acreages for each fruit and nut crop were then added to yield total acres by class. A technique based on productivity and yield was discarded as being unreliable because of the many factors which affect yield without changing the wastes due to pruning, spoilage, and termination. Acreages for individual field and row crops were extracted as reported in the census and then added to yield total acreages for each field and row class. All data, once collected and converted to its proper form, were adjusted to represent the base years 1955, 1960, and 1965.

Projections were carried out using a modified semi log computer program similar to that used for the industrial employment projections. Forecasts were made in five-year increments beginning with 1965 and extending to 2000 for each final activity class (15) for each county. Three to five growth curves were developed for each agricultural activity class for each county. Several techniques and tests were used to reduce these curves to one final curve for each activity class for each county, to be used in the derivation of agricultural waste loads.

For computer-mapping purposes, a separate base was established for agricultural activity. Data on agricultural activity by Minor Civil Divisions was used in conjunction with a moment centroid technique to determine the center of agricultural activity for each county. This center was assigned a row-column coordinate for map presentation.

EXISTING AND PROJECTED AGRICULTURAL WASTES

Because insufficient information exists to develop a reliable trend in future agricultural activity and because there is no conclusive proof that changes in crop yield significantly affect crop waste, the agricultural waste generation rates for each class were assumed to remain constant through time. Therefore, the procedure for derivation of projected wastes was a direct function. The waste production rate for each agricultural activity class given in Table 15-1 in tons/head/year or tons/acre/year was multiplied directly by the existing and projected number of head or acres in that activity class for all target years for each county. This was repeated for each agricultural activity class for all counties. The fifteen results for each county were added to yield total agricultural wastes by county in tons per year. The county waste totals were then added to obtain State waste totals for each target year in tons per year. Table 15-2 presents the total waste tonnages derived for each county for each target year and total agricultural tonnages for the State. Reasonableness checks were made using census trends for growth or loss of activity and using other reports, including California, for waste tonnages.

For comparison and analysis, the resultant agricultural waste tonnages for each county were divided by the respective total county land areas to yield agricultural waste density in tons per year per square mile. This information is presented on Maps 18 through 20. To increase the utility of the data, resultant total wastes for each county were combined with total municipal and total industrial wastes for each county and were divided by total county land area. Thus, the map series - Map 21 through 23 depicts total waste from all sources in tons per year per square mile for each target year. Absolute tonnages of total wastes from all sources in tons per year are presented in Table 15-3. For purposes of comparison, the scaling factor used on the map of total tonnages is the same as that used on the maps of municipal wastes alone and municipal plus industrial wastes. For greater differentiation and for purposes of comparison, the scaling used for agricultural wastes alone is smaller and is the same as that used for industrial wastes alone. A quick comparison of agricultural with the industrial and the municipal waste generation reveals that, to a great extent, agricultural wastes are highest where municipal and industrial wastes are lowest, which is expected. There are, however, areas of overlap in counties experiencing only moderate urbanization and industrial activity, but which are relatively active in agriculture, particularly in livestock and dairying. A good example of such a county is Chautauqua, with both furniture manufacturing and dairying, and yet possessing only a moderate level of urbanization.

In terms of absolute tons per year, agricultural activity in the State of New York generated some 22 million tons of waste in 1965. This is projected to decrease slightly each year to a low of 20,400,000 in 1985, then to increase again to about 21,200,000 by 1995, principally due to a projected increase in dairying and poultry raising. Since only those activities involving penned stock generate a waste (manures) which must be dealt with at disposal facilities (other agricultural wastes normally are disposed of on-site), and because wastes from this source average 40 to 50 percent of the total wastes in any target year, then the figure of tons per year to be considered drops to between 8 to 11 million tons.

Considering that as much as 60 percent or more of these manures are used on the farm or sold for fertilizer purposes, then the tonnage to be dealt with drops to as low as 3.2 million tons per year for disposal. However, there are trends toward replacement of natural manure with synthetic fertilizers; therefore, this figure could increase in the future.

On a county basis, the New York City area counties of Bronx, Queens, and New York (Manhattan) will remain constant at zero tons per year, while Kings begins with a small amount and declines. St.Lawrence County agricultural activity generated over one million tons of waste in 1965, a level which will remain above one million tons, though decreasing slightly, through

1995. There are two counties in which generated agricultural waste increases from 1965 to a level above one million tons per year by 1995 - Jefferson and Sullivan. Close to 50 percent of the counties generate a slowly increasing or decreasing level of wastes, averaging between 350 and 750 thousand tons.

With regard to the total waste picture, sources in the State of New York generated some 40.8 million tons of waste in 1965. This is projected to increase at an increasing rate to reach approximately 78.5 million tons by 1995, almost a 97 percent increase over and above 1965 levels. By 1995, 22 counties are each projected to generate a total of over one million tons per year, with four of these counties - Erie, Kings, New York and Suffolk - exceeding 4 million tons per year. The implications of such a tremendous volume of waste are vast. Only one county - Hamiltion - is projected to generate less than 100,000 tons per year by 1995.

REFERENCES

1. "Status of Solid Waste Management in California", California State Department of Public Health, (September 1968).

2. Raymond C. Loehr, "Animal Wastes - A National Problem", *Journal of the Sanitary Engineering Division,* Proceedings American Society of Civil Engineers, (April 1969).

Table 15-1

Agricultural Solid Wastes
Waste Production Rates

Activity No.	Category	Annual Waste Production Rate
	Wet Manures	
1	Chickens (Fryers)	6.4 tons/1,000 birds[1]
2	Hens (Layers)	67 tons/1,000 birds[1]
3	Hogs	3.2 tons/head[1]
4	Horses	12 tons/head[2]
5	Beef Cattle (feedlot)	10.9 tons/head[1]
6	Dairy Cattle	14.6 tons/head[1]
	Fruit and Nut Crops	
7	Class 1 (grapes, peaches, nectarines)	2.4 tons/acre[3]
8	Class 2 (apples, pears)	2.25 tons/acre[3]
9	Class 4 (plums, prunes, miscellaneous)	1.5 tons/acre[3]
10	Class 5 (walnuts, cherries)	1.0 tons/acre[3]
	Field and Row Crops	
11	Class 1 (field and sweet corn)	4.5 tons/acre[3]
12	Class 2 (cauliflower, lettuce, broccoli)	4.0 tons/acre[3]
13	Class 3 (sorghum, tomatoes, beets, cabbage, squash, brussel sprouts)	3.0 tons/acre[3]
14	Class 4 (beans, onions, cucumbers, carrots, peas, peppers, potatoes, garlic, celery, miscellaneous)	2.0 tons/acre[3]
15	Class 5 (barley, oats, wheat, milo, asparagus)	1.5 tons/acre[3]

[1] Determined from data reported in Cornell University Study (2).

[2] Estimated.

[3] Determined from data reported in State of California Study (1).

Table 15-2

Total Agricultural Wastes By County and State[1]
(1,000 Tons/Year)

	Years				
County	1965	1970	1975	1985	1995
Albany	170	151	138	145	300
Allegany	385	357	332	289	253
Bronx					
Broome	306	267	234	181	141
Cattaraugus	605	558	517	449	393
Cayuga	624	621	620	625	638
Chautauqua	704	689	677	662	655
Chemung	143	127	116	104	111
Chenango	618	580	545	484	433
Clinton	446	452	461	484	512
Columbia	420	447	483	594	784
Cortland	448	452	458	471	487
Delaware	780	693	616	493	392
Dutchess	407	392	382	369	364
Erie	580	555	538	527	554
Essex	98	88	79	65	53
Franklin	390	418	452	531	630
Fulton	110	103	97	87	78
Genesee	493	495	501	528	574
Greene	151	130	115	96	91
Hamilton	1	2	4	14	47
Herkimer	545	525	506	472	442
Jefferson	890	893	906	984	1,210
Kings		1	1	1	
Lewis	540	539	540	544	553
Livingston	498	465	435	384	342
Madison	636	624	614	598	586
Monroe	385	342	306	251	213
Montgomery	415	414	414	415	418
Nassau	10	7	6	4	3
New York					
Niagara	351	327	310	292	294
Oneida	840	809	781	730	685
Onondaga	486	448	415	357	310
Ontario	492	457	426	373	332
Orange	588	560	537	502	484

[1] Consultant's Analysis.

Table 15-2
(continued)

County	Years				
	1965	1970	1975	1985	1995
Orleans	329	328	330	339	356
Oswego	326	280	242	184	142
Otsego	711	658	610	525	454
Putnam	28	22	18	12	10
Queens					
Rensselaer	251	224	201	166	138
Richmond	7	7	8	10	12
Rockland	13	11	10	9	10
St. Lawrence	1,032	1,020	1,012	1,004	1,004
Saratoga	218	204	192	173	158
Schenectady	59	54	51	51	60
Schoharie	362	365	370	385	405
Schuyler	116	115	116	122	134
Seneca	224	217	210	198	188
Steuben	633	624	618	612	612
Suffolk	147	133	126	132	178
Sullivan	364	430	523	831	1,417
Tioga	302	287	275	255	240
Tompkins	275	261	251	235	223
Ulster	256	236	219	193	175
Warren	18	15	13	10	8
Washington	559	554	552	552	555
Wayne	433	416	404	391	391
Westchester	35	34	33	35	41
Wyoming	608	615	625	652	685
Yates	215	206	199	193	197
New York State	22,104	21,337	20,797	20,401	21,184

Table 15-3

Total Wastes From All Sources By County and State[1]
(1,000 Tons/Year)

County	Years 1965	1970	1975	1985	1995
Albany	508	502	548	731	1,176
Allegany	426	409	398	402	459
Bronx	1,225	1,254	1,448	1,950	2,646
Broome	543	530	568	783	1,361
Cattaraugus	721	639	614	594	633
Cayuga	703	709	732	836	1,137
Chautauqua	944	939	962	1,040	1,175
Chemung	278	274	293	379	549
Chenango	779	620	595	571	618
Clinton	509	518	330	607	755
Columbia	461	487	532	671	920
Cortland	510	508	521	558	613
Delaware	839	47	672	559	473
Dutchess	618	607	646	818	1,176
Erie	2,531	2,523	2,684	3,200	4,044
Essex	141	113	110	111	130
Franklin	423	454	495	601	751
Fulton	154	145	143	146	157
Genesee	562	574	604	744	1,335
Greene	176	156	144	137	150
Hamilton	4	6	8	20	55
Herkimer	652	602	605	642	752
Jefferson	965	970	995	1,114	1,429
Kings	2,477	2,450	2,728	3,503	4,625
Lewis	558	557	560	570	587
Livingston	538	512	497	500	586
Madison	675	668	671	704	806
Monroe	1,126	1,137	1,262	1,697	2,496
Montgomery	470	466	470	489	520
Nassau	1,495	1,531	1,757	2,415	3,320
New York	1,608	1,707	1,840	4,132	10,334
Niagara	719	723	786	7,021	1,498
Oneida	1,189	1,072	1,097	1,241	1,513
Onondaga	1,098	1,105	1,183	1,440	1,877
Ontario	56	540	528	538	633
Orange	788	798	856	1,083	1,523

---

[1] Consultant's Analysis.

Table 15-3
(continued)

County	Years 1965	1970	1975	1985	1995
Orleans	378	382	392	425	475
Oswego	431	394	379	389	458
Otsego	745	693	650	580	531
Putnam	58	60	72	119	215
Queens	1,732	1,827	2,131	2,921	3,993
Rensselaer	388	368	372	415	513
Richmond	271	308	386	622	997
Rockland	165	215	280	488	845
St. Lawrence	1,220	1,227	1,252	1,334	1,464
Saratoga	293	288	296	333	408
Schenectady	235	231	251	320	431
Schoharie	377	380	388	409	438
Schuyler	162	126	129	140	160
Seneca	252	246	245	251	268
Steuben	744	741	752	795	868
Suffolk	969	1,202	1,580	2,961	5,728
Sullivan	412	479	577	901	1,511
Tioga	334	323	319	324	349
Tompkins	342	334	338	364	421
Ulster	379	372	384	444	577
Warren	105	117	139	210	338
Washington	600	596	599	614	643
Wayne	535	523	524	551	617
Westchester	929	982	1,183	1,709	2,456
Wyoming	641	648	662	701	753
Yates	243	234	230	230	243
New York State	40,831	40,876	43,621	55,124	78,540

CHAPTER SIXTEEN

SPECIAL WASTES

GENERAL

A special waste is any refuse which presents a specific problem to one of the elements of any waste collection and disposal system when normal municipal practices are used. The term "special wastes" is more appropriate than "special solid wastes" because solids are only a part of the problem. Special wastes can include containerized toxic gases, radioactive wastes, sludges and slurries from chemical manufacturing processes and wastewater treatment plants, and even wastewaters which contain contaminants in a concentration so high, or of such a nature, that handling through a wastewater treatment plant is not practical. These wastes obviously may present problems when stored, processed, transported, handled, incinerated, or landfilled.

SOURCES, QUANTITIES, AND CURRENT DISPOSAL PRACTICES

The magnitude of the special waste problem in New York State cannot be defined at this point because of the almost total lack of information. There is little available literature written from a viewpoint of special waste. However, some general information can be gleaned from the results of the State survey, from communication with governmental agencies, and from the industrial experience of the ROY F. WESTON professional staff. The major sources of special wastes will be discussed to establish a basis for an understanding of their uniqueness and the importance of special consideration.

RADIOACTIVE WASTES

There are two Atomic Energy Commission-approved sites in New York State for the disposal of radioactive wastes. Cornell University operates a small site for the waste it generates in its research laboratory. This waste, however, is almost insignificant when compared to the amount of waste handled at the Nuclear Fuel Service Disposal Site in Cattaraugus County. This site is the major disposal site for the eastern United States. Nuclear power stations generate most of the waste received, with small contributions coming from research laboratories, private industry, and hospitals.

Approximately 30 percent of the waste buried at the site (4,300 cubic yards in 1968) is generated by Nuclear Fuel Services. The remainder is delivered by private contractors. Only about 1 percent of the waste received is considered a high-level waste, i.e., with radioactivity greater than 200 mr/hr (milliroentgens per hour).

Presently, there is only one nuclear power plant producing radioactive waste in New York. However, there are three new plants under construction, which upon completion in late 1969 should increase the nuclear power output in the State from 275 to 2,400 megawatts. Future plans call for the building of at least four more plants by 1978, which will increase the total power generation by nuclear power plants to approximately 6,400 megawatts or about 25 times the current output of 275 megawatts. The radioactive waste output in the future should increase proportionally with the proposed development of nuclear power in New York.

The information received has facilitated locating the major contributors of radioactive wastes and the current disposal sites in operation. Figures are also available for total waste quantities that are disposed of in New York State. These figures, however, do not indicate the fraction of the waste that is produced in New York State. Nuclear power plants contribute the major portion of radioactive waste loads. With the projected completion of eight nuclear power plants in New York State by 1978, some better method of estimating nuclear waste production should be developed. This is necessary to determine the required disposal site capacity and to effectively manage waste disposal.

Operational wastes exposed to radioactive contamination, such as clothing, towels, research equipment, and waste resins from cooling water, are produced in predictable quantities. These wastes will also have some relation to the size of the plant.

However, a large quantity of this waste is unpredictable. Spills and handling accidents at nuclear power plants require the removal of all machinery, clothing, building material, etc., that suffered contamination. Although accidents are rare, the quantity of wastes is considerable and cannot be directly related to the size of the plant.

MINING WASTES

The standard industrial classification system of the Department of Commerce indicates that there are eight different classifications of mining operations in New York. The majority of these operations consist of sand and gravel or crushed stone extraction. The limited metal mining in the State produces the greatest quantity of waste, which consists mainly of inert country rock and very low grade ore which cannot be processed economically. The quantity of material to be removed presents the biggest problem to disposal, but the general location of such operations and the nature of the material makes it suitable for landfill disposal at or adjacent to the operating site.

The location of mining operations classified by standard industrial classifications (SIC) is reported in a State-wide industrial waste survey. In a few cases, estimated waste output is provided. For instance, six sand and gravel operations reported a collective average waste production of about 20 tons per day, while the reported wastes from crushed stone operations averaged 120 tons per day. Metal mining is the largest waste producer with 1,790 tons per day coming from one lead-mining operation and 2,600 tons per day produced from one iron-mining operation.

The majority of the mining operations are undefined as to daily waste production, size of operation, and number of employees. While this information would facilitate the computing of unit values of waste production and permit defining the geographical distribution of mining wastes in New York State, it is believed this is not necessary. As stated before, mining operations permit extensive use of on-site disposal. This is especially true since mining is an extractive process, and most of the waste produced could be used to fill the pits, etc. created.

However, some regulation and study may be required, because the chemical nature of some mining wastes, if coupled with a poor disposal site selection, may result in serious impairment of local ground-water resources.

DREDGINGS

In New York State, the dredging of all navigable waterways is performed by the State Department of Transportation and by the U. S. Army Corps of Engineers. The Department of Transportation is responsible for maintaining the 520 miles of the State Barge Canal System and Connecting Waterways. It is estimated that 1.45 million cubic yards of dredged material is removed from the system yearly.

The Corps of Engineers divides the State into two districts, with district offices in New York City and Buffalo. The New York City office has jurisdiction over maintenance and special project dredging in Lake Champlain, the Hudson River, New York Harbor, and the waterways around Long Island. The Buffalo district includes harbor dredging for ports along the shores of Lake Erie, Lake Ontario, and the St. Lawrence River. In 1968, close to 30 million cubic yards of material was dredged from Lake Champlain alone, and 100,000 or more cubic yards from the Hudson River.

Disposal of dredged material is usually accomplished by pumping into lowland areas close to the shore, where the material can drain. State lands are used for this purpose unless specific requests are received for fill material on private land. In the New York City area, where available land is scarce, dredged material is usually barged to deep sea dumping grounds six to eight miles off-shore. The Buffalo District has specific off-shore disposal sites in the Great Lakes for its dredged material.

Because dredging operations are carried out as the need arises, specific waste loads at specific locations cannot be predicted. However, dredgings present a complex disposal problem due to their large volume and sometime organic nature, and constitute a significant factor in planning the disposal of special wastes.

INDUSTRIAL SPECIAL WASTES

A majority of the industries in New York State can be expected to produce at least one type of waste that can present a waste disposal problem. This special waste can be in either the liquid, gas, or solid state and is considered special because of its size, reactivity, or the problems related to or resulting from its disposal.

A knowledge of the processes and operational procedures involved in an industry makes it possible to define qualitatively the possible classes of waste that may be produced. However, without specific knowledge of an industry's actual capacity and waste production potential, it is impossible to arrive at any estimation of quantities.

Current disposal methods practiced by industry have included burial, incineration, lagooning, and dilution. In most cases, industries have acted independently of each other to solve their specific disposal problems, resulting in a wide variation in disposal practices and techniques. Data from the industrial waste survey by New York State Department of Commerce are insufficient to define the industrial special waste problem in New York State. Only a small percentage of the industries in the State provided an estimate of total waste production, and these estimates do not identify types of wastes.

A major effort is required to accumulate sufficient data for definition of the industrial wastes problem. Guidelines for this effort are outlined in Chapter Seventeen.

MUNICIPAL WASTEWATER SLUDGES

Because of the extensive design work done in the field of sewage treatment, relatively constant per capita sewage quantities have been developed. Generally, 0.25 lbs/capita/day is the accepted value for the total quantity of dry solids generated and produced in the treatment of sewage. This value can double depending on how extensively garbage grinders are used, the nature and quantity of industrial wastes entering the system, and the treatment process used. To accommodate these variable waste factors, a value of 0.30 lbs/capita/day for dry solids production seems reasonable for forecasting purposes.

It should be understood, however, that this solids production is a dry weight figure and does not account for the moisture content of the sludge. The percent moisture can vary from 99.5 to approximately 50 percent, depending on the sludge source and the degree to which it has been treated and dewatered. This moisture will significantly increase the volume and weight of the waste to be disposed of and should be considered in any determination of sludge quantity. Listings are available which locate all treatment facilities in the State, the populations they serve, and the degree of treatment provided. These listings furnish the data necessary for a reasonable estimate of the current sewage sludge production; however, this information is of limited use because New York State has recently started a program to upgrade some existing plants, abandon others, and construct a considerable number of new plants.

Areas not served by municipal sewers produce solids which are termed scavenger wastes. These are slurries pumped from cesspools, septic tanks, and similar facilities. The quantity of waste depends on population served and frequency of pumping, which is related to soil conditions, degree of enforcement of ordinances, and attitudes of owners. One county solid waste management study indicated "that, on an overall population basis, the per capita contribution of scavenger wastes varied from 0.1 to 0.8 gallons per day".[1] At one percent solids, this scavenger waste production rate is calculated at 0.008 to 0.06 lbs/capita/day.

[1] "An Action Plan for Solid Wastes Disposal in Suffolk County, New York: Volume 2 - Detailed Report", John J. Baffa, Consulting Engineers.

It is reasonable to assume that 85 percent of the State population will be serviced by municipal sewerage systems in 1995. On that basis and assuming that the remaining 15 percent of the population produces sewage solids at the maximum of the reported scavenger range, a total sewage sludge contribution can be determined. The municipal contribution will be 0.255 lbs/capita/day, (0.85 x 0.30) and the on-site contribution will be 0.009 lbs/capita/day, (0.15 x 0.06) for an overall sewage sludge production of 0.264 pounds of solids/capita/day. This rate when multiplied by the projected 1995 State population would yield a State total of 1.19 million tons per year, which is about 1.5 percent of the projected solid wastes from all sources. Thus, even with the highest reported scavenger waste production rate, the contribution of sewage sludge to the total solid waste load would not be significant from a quantity standpoint in 1995 and would be even less so in the intervening years, when the proportion of the population without municipal sewerage service would be higher. However, the nature of the sludge requires special handling and could be a problem in certain areas.

The ultimate disposal of raw and digested sludge usually requires a drying or dewatering step before burial or incineration. There are some instances where sewage solids have been used for fertilization and irrigation, but this has not been a universally accepted practice.

WATER TREATMENT SLUDGES

All the water treatment facilities in New York State can be expected to produce waste sludge to some degree. The amount of sludge generated, however, is difficult to determine without specific information. Unlike sewage solids, water treatment sludges are not completely dependent on the population served. The amount of sludge also depends directly on the raw water quality and the type and degree of treatment required.

From the limited data available, estimates of the sludge production from the treatment of a New York State surface water supply ranged from 50 to 200 pounds per million gallons of raw water treated. By assuming an average daily consumption of 100 gallons/capita, the daily sludge production in lbs/capita varied from 0.005 to 0.02. When compared to a typical daily refuse production of 4.4 lbs/capita, the water treatment sludges compute to be less than 0.5 percent of the total waste load. Even so, special consideration must be given to this waste due to its physical nature and its geographical distribution.

Currently, water treatment sludges are discharged to watercourses and in some cases, to waste treatment plants where some lagooning and drying beds are used. Only recently have regulatory agencies begun to require treatment of water plant sludges. Since these wastes are essentially non-combustible, incineration is not practical, and landfills cannot accept these solids unless they have been dewatered. These materials will present substantial technical problems. Therefore, water treatment plant sludges must be included in solid waste planning.

SITE AND FACILITY RATING

The preliminary State-wide solid waste survey provided little information about the special waste handling ability of existing facilities and sites. The survey reported whether or not sewage solids, waste oils, and hazardous materials were rejected. From this it could be inferred that facilities and sites not accepting these wastes did not have the capability for handling them; however, no conclusions could be made on those accepting these wastes. The survey report was also unable to indicate what differences existed between those accepting certain wastes and those rejecting them. Without knowledge of the total special waste situation and the differences between the disposal sites and facilities, determination of current capabilities and rating of operations cannot be made.

Land disposal sites in the State which were considered for special waste ratings were those sites with a land area of at least 100 acres and an expected life span of greater than five years. There were twenty-six sites that met these limitations, and thirteen of the sites were reported to have accepted one or more of the three previously-mentioned special wastes. Eight of the sites supposedly accepted hazardous material, but no definitive statements are available to indicate what these materials are and whether good practice would have prohibited their acceptance. No mention is made of the techniques or procedures used for the disposal of these wastes or the quantity in which they exist.

About one third of the 77 incinerators in the State (excluding the 4 sewage sludge incinerators) accept at least one of the special wastes mentioned and more than half accepted only sewage solids. A total of 8 incinerators accept hazardous materials, while 10 reported the acceptance of waste oils. Most of the incinerators in the State are for typical municipal refuse. For the few facilities that did have some special waste capability, no comparative information concerning equipment or handling techniques was available for rating them.

SITE AND FACILITY MODIFICATION

The majority of existing facilities and sites in New York State handle typical municipal refuse. Only a very small percentage appears to have any special waste handling capability, which, in most cases, is undefined.

Industrial special wastes present the greatest problems to disposal and will greatly influence site modifications. Depending on the nature and quantity of the waste, changes will involve both equipment and operating procedures. Equipment changes will involve waste handling, storage, feeding, pollution control, and general expansion. Procedural changes may include strict control over waste type, quantity, location relative to other wastes at site, scheduling of actual disposal, and the training of personnel to handle wastes properly.

Until more specific information as to capabilities and type of waste received is obtained, it will be impossible to estimate individual modifications. Additional information and data collection guidelines are presented in Chapter Seventeen.

CHAPTER SEVENTEEN

SUPPLEMENTAL DATA REQUIREMENTS

APPROACH TO FUTURE STUDIES

The development of an overall solution to the solid waste problem in New York State begins with planning and rationally proceeds through an engineering phase toward a continuing phase of management and regulation.

The planning phase is concerned initially with the development of a State-level approach, and later with the preparation of a master plan for the phase development of solid waste management systems. More specifically, the master plan will identify site locations, type and capacity of facilities to be constructed at the sites, and major solid waste transportation arrangements, all of which must be designed and phased to collectively provide the most efficient and economical disposal of the solid waste anticipated in the future. The necessary sites and facilities should be designed in detail and constructed in the engineering phase.

The management phase is initiated some time before construction to provide the financing required; however, it is primarily concerned with operations--maintaining and improving quality and coverage of service. This task has many facets. Some of these are involved with planning such as the periodic review and updating of local, regional, and State solid waste planning; others are concerned with technology such as Research and Development and technical assistance; and others are involved with such varied aspects as manpower training, public information, and grants-in-aid. To support the State goal for economical, efficient solid waste disposal without causing air pollution, water pollution, a nuisance or a public health hazard, regulation of management is essential. This would be in the form of provision of new legislation, monitoring of operations, and enforcement of existing legislation.

This study is in the initial step of the planning phase - the development of the State-level approach. Subsequent studies, by State agencies or by qualified consultants under State sponsorship and direction, are required to take the solution process through the remaining planning elements, through the engineering phase, and into the management-regulation phase.

GENERAL DATA REQUIREMENTS

The data developed to date are sufficient to accomplish the objectives of this study. Whether or not these results are sufficient for subsequent studies depends, of course, on the objectives of those studies. Although the scope of those studies cannot be fully defined at this time, it can be assumed that some will be sufficiently sophisticated in concept to require improvement in the existing data, and that others will be so entirely different in concept that new types of data will be required.

In defining supplemental data requirements, it is recognized that the efforts involved in data collection would be minimized if the data development in the initial studies is patterned to form a data basis for the subsequent studies. That is, rather than having to disregard existing data at the outset of each study and collect totally new data, less effort is obviously required if just the refinement of the data used in the previous study is sufficient. This condition can be achieved only if current data collection is directed towards meeting the ultimate requirements of the most sophisticated study that is anticipated. Although this would reduce overall collection efforts, it may also result in a considerable delay in the initial studies. This delay would be brought about by having to ignore readily available data, sufficient for only the initial studies, and collecting data which is sufficient for all studies but not as readily available.

Thus, if delays are unacceptable, there should be two or three separate and possibly concurrent data collection tasks: one task directed towards meeting the requirements of the immediate studies, one task directed towards meeting the requirements of the final studies, and, if necessary, one task directed towards meeting the requirements of the intermediate studies. It is in this sense that the actions outlined in this chapter are recommended.

PLANNING DATA NEEDS

The development of a solution for the New York State Solid Waste Management problem is still in the planning phase. Remaining in this phase is the development of a master plan which specifies the combination of solid waste management operations throughout the State and their phased development which will meet the objectives of the State program while providing maximum benefits. Obviously, there are innumerable alternatives for accomplishing these objectives, each having different technical, economical, and social consequences which must be examined in the decision-making process. Systems analysis is a highly useful tool for examining possible alternative means. In this sense, the process of deciding on the location and size of sites and facilities, the quality of their operation, the distribution of waste from their sources to the facilities, and the schedule of the time for the development of these activities should consist, in part, of the solution of mathematical programming problems formulated to provide information on the technological and economic consequences of the promising alternatives. This information together with thoughts on the many social aspects involved in the solid waste problem will provide a basis for decision-making.

The data collection and development required to meet the ultimate information needs of the planning phase will be implicit in the definition of objectives. It is apparent that at least the following will be required:

1. Waste Collection Procedures

   Information is needed on the solid waste collection procedures, efficiency, and equipment in the local areas, so that the total system plan can reflect these problems.

2. Waste Quantities by Type of Waste

   Additional data collection and development should be accomplished to refine existing waste production rates for municipal, agricultural, and industrial solid waste to provide more accurate projection of quantities of waste, by source, for the target years desired.

3. Existing Facilities and Land Disposal Sites

   Information is needed on the feasibility for continued use, the special capabilities, and the capacities for existing incinerators, landfills, and transfer stations. It is recognized that existing facilities should be used to the fullest extent possible without adversely affecting the environment.

4. Facility Costs

   Reliable estimates of capital and operating costs are required for various types of handling and disposal facilities (both existing and projected) for different kinds of solid wastes, including cost relationships for ranges of waste quantity. Costs are of paramount concern in decision-making.

Each of these four areas of data requirement and the guidelines for collecting these data will be described in this chapter.

COLLECTION PROCEDURES

Surveys of collection practices in various cities have shown that collection time can vary from less than one man-minute per service to as high as twelve man-minutes. Some of this variation occurs because of unavoidable problems in topography and because of weather problems (such as ice and snow), while in other cases poor equipment or outright inefficiency causes the difference.

Since as much as 80 percent of solid waste disposal costs is involved with collection, an effective State program must look at sufficiency of collection practices. If collection is inefficient, a per capita grant-in-aid program may only perpetuate these inefficiencies rather than provide incentive improvement of disposal practices, unless appropriate guidelines are included in the program. One problem associated with the implementation of such a State program results from the practice of selecting an inter-municipal or regional disposal site on the basis of a weighting of the refuse quantities and collection and travel times for the various communities involved. If this weighting process includes an inefficient community, the efficient operations would be unfairly penalized.

It is not the responsibility of the State to conduct collection time studies for re-design of local operations, but it is a State responsibility to ensure that funds are granted only for improvement of effectiveness, and that local plans are correctly designed where inter-municipal cooperation is proposed. These responsibilities require a knowledge of the collection efficiency and governing conditions.

The data required are tabulated below. They must be collected by spot survey or (preferably) by requiring continuous recording by the local communities over a period of time.

A. Basic Data

1. Collection frequency and schedule (domestic and commercial)
2. Container location (curb-side or backdoor)
3. Type of container (cans, sacks, non-specified)
4. Type and size of collection vehicle (domestic and commercial)

5. Crew size and individual duties (collect, drive, drive and empty tubs, etc.)

6. Wastes collected (household, bulky, yard wastes, etc.)

7. General (manpower problems, equipment age, etc.)

B. Survey Data

1. Arrival time at disposal site.

2. Services collected per trip (if not able to be counted each trip, may be averaged over the day, or week, from the route design figure).

3. Travel time from "full" point to disposal site.

4. Travel time from truck yard to beginning of route.

5. Starting and quitting time.

6. Full and empty weight of truck at disposal site (if possible).

In addition to the above data, an objective observer should evaluate community factors which affect collection such as:

1. Topography

2. Width of streets and alleys

3. Number and frequency of open spaces with travel but no collection

4. Lot size (width, plus depth if back-door collection)

Determination of the above elements will not be a substitute for detailed investigation to re-design collection procedures, but will provide precise information for evaluating a community collection system.

WASTE QUANTITY INFORMATION

The second area of data requirements involves detailed quantitative information on waste quantities by type of waste. As indicated earlier in this report, data on the generation of solid wastes are extremely meager except in locations where effective detailed studies have been conducted. As a result, only two approaches to this data have been devised.

1. General consideration of gross quantities and type of wastes, and

2. Highly-detailed studies for specialized problem-solving or research into domestic waste characteristics.

Neither form of data is appropriate to a State program which includes development of a Master Plan, and in many cases has been inappropriate for a local program in that each succeeding data collection step could not build upon what was done previously, thus requiring a new, more costly effort to collect the desired additional data.

The chief cause for this data dilemma is the absence of a means of classifying wastes into functional categories which can provide a basis for further detailed classification when needed for design, and still provide an indication of problems to be encountered at lesser levels of detail.

A classification system for refuse should serve a useful purpose beyond that of simply providing a name for a certain waste material. The potential functional uses for such a refuse classification system are:

1. Provide information on storage, handling, or disposal problems and potentially effective remedial methods.

2. Serve as a checklist for the study phase of a waste disposal project, to insure that all types of waste are ascertained, that each is recognized for its own peculiar problems, and that facility design effectively solves those problems.

3. Serve as a checklist on potential problems for an existing disposal facility which may have been requested or has been forced to handle a new type of waste material.

To serve all of the above purposes, the classification system must be complete. That is, it must be structured to be able to place any and all materials into an appropriate slot. This, of course, requires a system not directed at any single waste (such as municipal solid wastes), but rather at all types of refuse including industrial and institutional solid wastes and even certain liquids and gases.

Such a classification system has been developed, and is outlined in Table 17-1. The system is complete, in that the combined knowledge of the staff of ROY F. WESTON and of the New York State Department of Health has been reflected in its categories and classes. It has not yet been tested, however, and some modification may be required when it is put into practice.

PROPOSED SYSTEM OF NOMENCLATURE AND CLASSIFICATION OF REFUSE

MAJOR CLASSES

Solid Wastes
Liquid Wastes
Gaseous Wastes

FUNCTIONAL CLASSES

The first subdivision of the major classes. It is generally a physical description of the type of refuse, used because that description denotes a particular problem, usually in collection and handling. A data collection program geared to this level of definition will most probably be sufficient for a State-level study.

ANALYTICAL CLASSES

The second subdivision of classes of refuse. It will generally be a chemical description of the nature of the material, used because that chemical description either denotes a particular problem in collection, handling or disposal, or immediately provides problem definition information about the material. Some of these classes are repeated under several functional classes. Data at this level is needed for engineering design of facilities for collection, handling, or disposal.

The tabulation of proposed classes shown in Table 17-1 is intended to be complete, rather than typical. That is, all possible refuse classifications have been listed. Certain functional classes contain sufficient description within themselves that no analytical classification is required to further describe them (e.g., abandoned automobiles).

In its use, any given waste may have more than one location in the system. The user must select the most critical classification based on his particular disposal or handling system. For example, a dead animal is always a putrescible, but if also pathological, it may be preferentially listed as pathological. Again, a bottle is just a piece of non-combustible mineral, but if it contains gasoline, it suddenly becomes a fire bomb. If the data collection precedes system design, then a certain item may have to be listed in more than one place until the design basis is chosen.

When the classification "Others - Not Elsewhere Classified" appears, it is not intended to be a catch-all for items forgotten or not considered. Rather it should contain only materials specifically determined as not containing a contaminant that would place it in a problem category. Therefore, it represents the best and cleanest materials, not miscellaneous problems.

Classifying wastes by this type of system provides significant problem-solving information about the specific waste and all others in that category. This type of information is an important step in development of an effective solution to solid waste problems.

With the classification system as a base for data collection, consideration may now be given to the specific use of the system and the details of the data collection effort.

A. Preliminary Data Solicitation

1. Municipal - A questionnaire should be prepared, based on the waste classification system. It should be a basis for data collection in comprehensive plans yet to be completed, for comparison with data sufficiency in completed plans, and for circulation to communities which require additional data. It should be similar in type to the National Survey forms, but must answer those questions found wanting when these forms were analyzed. Interviews should be conducted by knowledgeable solid wastes engineers, and must include:

   a. Details of means of control and delivery or rejection of wastes at the disposal site.

   b. Details on means of waste quantity measurements.

   c. Details on decisions for acceptance or rejections of wastes.

   d. Details on method of delivery of wastes by element in the waste classification system.

   e. Quantitative information on each type of waste received by element in the waste classification system.

   f. Density information on volumetric waste quantities.

2. Industrial - A second questionnaire should be developed to obtain industrial waste information. It will contain most of the above questions, except that the ability to accept or reject wastes will not be appropriate.

B. Secondary Data Collection - Many of the questionnaires will be incomplete, and in the case of industry, total lack of knowledge may be evident. A secondary program will then be required to fill in data gaps. This program will vary from location to location, depending upon the attitude and cooperation of the entity visited. It may include any one or more of the following:

1. Assignment of a State Engineer for about two to three weeks to set up and/or conduct an intensive study.
    a. Set up the program and train local people to continue.
    b. Collect data over the intensive period and encourage the local people to continue or spot repeat the program.
2. Provide guidelines for a data collection program to be reported periodically or continuously.
3. Collect basic information on the locality so as to apply waste generation rates developed from other more comprehensive studies.

Collection of data on generation of solid wastes must be a phased program, and once underway, must be continuous. Many types of solid wastes have never been classified or counted because they have been outside the usual sphere of influence of the traditional solid waste agencies. Therefore, the first trial in data accumulation will encounter many entities who have never reported or even considered the functional problems of the various waste elements and may be subject to much error and frustration. Subsequent efforts should be considerably more satisfactory. The data collection should be geared to the entity which generates solid wastes, and therefore, two separate programs are required as outlined above - one for domestic wastes and one for industrial wastes.

EXISTING FACILITIES AND LAND DISPOSAL SITES

The third necessary data area covers information required on present solid waste handling and disposal facilities. It is necessary in a comprehensive solid waste management study to evaluate existing land disposal sites and incinerators to determine the feasibility of their future use. It is also necessary to define the unused capacity of sites and the remaining life of incinerators. As previously stated, no reasonable determination of these aspects could be made from the information provided by the State-wide survey, which was not designed for this purpose. The considerations which follow are presented as general guidelines for obtaining the pertinent data.

Incinerators - It is not practical to provide one set of guidelines for detailed evaluation of incinerators, because each incinerator varies tremendously in its ability to be modified to be effective in air pollution control, or to handle a new variety of industrial wastes. Thus, any single set of guidelines would have to be general enough to serve for any incinerator situation, and this generality defeats the purpose of rating the specific facility. Furthermore, incineration as practiced today has not been effective in protecting the environment nor in handling and disposing of all wastes generated in the area it serves. Therefore, the only practical method of rating an incinerator is through an intensive study (about one to two weeks) by an engineer who has a knowledge of most or all of the elements in the waste classification system and a thorough knowledge of combustion processes.

Such a program is of definite value to New York State in its long-range planning effort and should be instituted for those incinerators which are either located strategically or are new enough for possible incorporation into any long-range plan. If such expertise is not available on the staff of the New York State Department of Health, it should be procured from outside sources.

Transfer Stations and Waste Processing Facilities - The justification and basis of design is to reduce waste handling costs by permitting collection vehicles to dump a full load at a point closer to the collection operation, and thereby return to collection more rapidly. This type of facility, although much less complicated, requires the same form of approach to evaluation as incinerators. Most of the transfer stations in operation today were built to handle only domestic solid wastes.

If such a facility can be justified for a normal municipal collection vehicle with 16 or more cubic yards of refuse capacity, it might be far more easily justified for certain industrial wastes which are generated in lots as small as three cubic yards and occupy a truck to move that relatively small quantity. Yet seldom are the industrial wastes handled through a transfer station.

If any form of long-haul of refuse to centralized disposal facilities is contemplated as an alternative for the Master Plan, the success of that alternative may completely depend upon the ability to make economical movements of the specialized waste materials. Therefore, the same knowledge of the elements in the waste classification system required for evaluation of incinerators applies to the evaluation of transfer stations.

Land Disposal Sites - In marked contrast to incinerators, land disposal sites all have much in common. Their ability to accept or reject wastes is far more a function of the waste itself than of the landfill. Factors such as topography, climate, and geology relate more to whether or not the site should be used at all, rather than to any relative value of a site. Also, technological advances are not anticipated to produce any marked change in the ability of a landfill to receive more wastes without harming the environment. Rather, as more is known about the various waste materials, it is expected that new levels of rejection from landfills will occur.

This "yes or no" type of situation lends itself more readily to development of a single set of guidelines for evaluation of land disposal sites, whether existing or proposed. Furthermore, the basic nature and lesser complexity of the factors themselves permit effective evaluation of a site by persons with less specialized expertise than with incinerators. For these reasons, guidelines for evaluation of land disposal sites have been developed and are included in Table 17-2.

The primary considerations involved in evaluating existing land disposal sites to determine the feasibility of their future use include: the accessibility of a site to communities served, the relative economic impact of improving a site to acceptable standards, and the definition of acceptable standards. There is little advantage in considering existing operational characteristics, such as frequency of daily cover, because some sites presently operated as serious nuisances may only require some minor adjustments to be acceptable as sanitary landfills. Therefore, only those factors which are pertinent to inclusion of the site into the Master Plan need be evaluated.

Collecting such data on all 921 land disposal sites in New York State would be a task of major proportions, but this is not required. Information from the State survey indicates that only about 25 sites have a life expectancy of greater than five years (indicating some unused land available) and a total acreage of 100 acres or more. Performing the necessary data collection on only these 25 sites should not limit any subsequent decisions, because the remaining sites have so little unused space that they are of little consequence in a regional plan.

FACILITY COST RELATIONSHIPS

The fourth and final area of data needs involves the cost information necessary to economic evaluation of alternatives. These factors are extremely important in any decision-making process, but present costs are important only where present facilities are to be continued for some period of time in the long-range plan. During the preliminary and secondary data collection phases, details of operating and depreciation or amortization costs should be obtained for any facility with a potential life sufficient to be a possible part of any long-range plan. If not available, procedures should be instituted to make such costs available.

Within a few weeks after this report is published, the U. S. Public Health Service booklets on the accounting procedures for landfills and incinerators should be available for distribution to any agency which requires guidance on such matters. These booklets, plus the comments of the technical staff personnel who visit each site, should be sufficient to establish the manner of data collection.

Costs obtained from old facilities will not be applicable to costs for new facilities, or even for costing required modifications to the old facilities. Such costs will have to be developed from the literature or from the experience of the engineer.

SUMMARY

Part II of this report has discussed and evaluated previous solid waste data collection efforts, and found that while considerable information has been obtained on the status of solid wastes collection and disposal, very little of the data is useful in providing a basis for decision-making. Totally new data were required to complete the objectives of this study, and many of the Chapters in Part II document the approach to data development which was used.

While the new data have been effective in providing a basis for determination of directions for the New York State plan and program, they are too general for development of a Master Plan, and even less adequate when viewed as a basis for decisions in an engineering plan for implementation. Thus, Chapter Seventeen has outlined an approach to subsequent data collection efforts which is both consistent between levels of detail in data collection and effective in providing only that amount of detail required at each level of planning and implementing activity.

Table 17-1

Waste Classification System

Class	Remarks	Example
I. Solid Wastes		
A. Putrescibles		
Household Garbage		
Vegetable and Fruit Processing Wastes		
Animal Manure		
Dead Animals		
Meat, Poultry and Seafood Processing Wastes		
Others, Not Elsewhere Classified		
B. Bulky Combustibles	Bulky is defined to mean a material of a size to present problems by jamming in a compaction truck hopper, an incinerator feed chute, or other such problems in handling or disposal. Its dimensions may not be defined, except by the size and nature of handling or disposal equipment.	
Wood		Timbers, pallets, cross-ties
Paper and Paper Products		Large cardboard packing boxes, box car linings
Cloth		Filter cloths, mattress
Plastics		Styrofoam logs, polystyrene sheets, garden hose
Rubber		Belting, tires
Leather		Conveyor belting
Yard and Street Wastes		Tree limbs
C. Bulky Non-Combustibles		
Metal		Drums, bedsprings
Mineral		Carboys, bathroom fixtures
D. Small Combustibles	Small is defined to mean a piece of waste material of a small enough size so that no danger of jamming equipment, or otherwise causing problems because of its size. It refers to the size of a piece of the material, not the size of the delivered load.	
Wood		
Paper and Paper Products		
Cloth		Gloves
Leather		Shoes
Plastics		Milk cartons
Rubber		Galoshes, butyl rubber crumb
Yard and Street Wastes		Street sweeping, leaves
E. Small Non-Combustibles		
Metal		Cans
Mineral		Bottles
Ashes		Furnace ashes
F. Non-Empty Cans, Bottles and Drums	This functional class will require precise defintion of the contents by one of the other classes. It must be considered to establish the quantity of material delivered in this manner instead of in bulk form.	Solvent drums Bottles of wastes from laboratories
G. Gas Cylinders		Oxygen, acetylene
H. Powders and Dusts		
Organic		Pesticides, grain dusts, chemical powders, coal dusts
Metallic Inorganic		
Non-metallic Inorganic		
Explosive		

Table 17-1
(continued)

Class	Remarks	Examples
I. Pathological Wastes		
Cloth, Paper and Plastic		
Animal and Human Wastes		
Instruments and Utensils		
J. Sludges	Materials which are solid in appearance, but are wet, either from water or liquid organics. The solids portion is classified.	
Chlorinated		
Brominated		
Fluorinated		
Acid		
Alkaline		
Water-Reactive (unhydrolyzed)		
Air-Reactive	May represent a material highly reactive with the moisture in air, or with the oxygen in the air.	
Putrescible	May represent the wet form of any of the materials listed under the Functional Class of the same name, but also includes such materials as wastewater treatment plant sludges.	
Miscellaneous Organic		
Metallic Inorganic	Refers to metals in the uncombined form.	Particles of metal in oil
Non-metallic Inorganic	Inorganic compounds.	Filter cakes, $CaCO_3$ precipitate
K. Demolition and Construction	This functional class will be subdivided into the Analytical Classes shown for bulky and small, combustibles and non-combustibles. It is included as a separate class to quantify materials from this source, and to recognize that a delivery may contain a wide mixture of large and small combustibles and non-combustibles.	
L. Abandoned Vehicles		
M. Radiological Wastes	This functional class will require further definition by one of the other classes. It must be considered to define this type of contamination to refuse, and to consider the special measures involved.	
II. Liquid Wastes		
A. Wastewaters	Waste liquids composed almost entirely of water, but containing contaminants in low enough concentration (usually much less than 1.0 percent) to be handled through a sewer system to a wastewater treatment plant. This definition is proposed for exclusion purposes, since these wastes are not considered normally as refuse.	
b. Contaminated Waters	Waters containing contaminants in a concentration too high, or of a nature, that handling through a wastewater treatment plant is not practical.	
Chlorinated		
Brominated		
Fluoridated		
Acid		
Alkaline		Blood, grease
Putrescibles		
Insoluble Oils		
Soluble Oils		
Toxic Organics		
Toxic Inorganics		
Soluble Metals		
Others, NEC		

Table 17-1
(continued)

Class	Remarks	Examples
C. Liquid Organics	Liquid at all ambient temperatures.	
Chlorinated		Many solvents
Brominated		
Fluorinated		
Sulfurated		
Acid		
Alkaline		
Water Reactive (unhydrolyzed)		
Shock Reactive		
Toxic and Hazardous		Pesticides
Soluble Metals		
Others, NEC		
D. Tars	Stiff materials which are semi-solid at low ambient temperatures.	
Chlorinated		Chlorine-substituted hydrocarbons
Brominated		Bromine-substituted hydrocarbons
Fluorinated		Fluorine-substituted hydrocarbons
Sulfurated		Sulfur-substituted hydrocarbons
Acid		Low pH, corrosive solvents
Alkaline		
Water-Reactive		Unhydrolyzed materials which react violently with water
Chemically Reactive		
Self Reactive (monomers)		
Toxic and Hazardous		
Soluble Metals		Sodium, calcium
Others, NEC		
E. Slurries	Liquid materials which contain solids, but which readily flow or pump. The liquid and solid materials both are classified.	
Organic in Water		
Inorganic in Water		Lime slurry
Organic in a Liquid Organic		
Inorganic in a Liquid Organic		Metallic sodium in oil
III. Gaseous Wastes	This classification is restricted to those gaseous materials which have been or might become the responsibility of a disposal group or department to treat, burn, or otherwise alter before discharge to the atmosphere.	
A. Odorous		Mercaptans, H_2S
B. Combustible Particulate		
Solids		
Mists		
C. Organic Vapors		Volatile solvents
D. Acid Gases		SO_2, HCl

Table 17-2

Guidelines for Evaluation of Land Disposal Sites

These evaluation guidelines include only the information which is basic to the fundamental value of the site. It ignores any element which may readily be altered by a change in operating procedure.

ACCESS ROADS

1. Are the site and access roads negotiable by all types of vehicles in all weather? Is the maximum grade less than 5 percent? Is proper slope and drainage provided?

2. If the access road is deemed insufficient, can it be improved or must a new access road be constructed? What efforts will be required (distance, type of terrain, bridges, etc.)?

3. Are there any alternate sites for disposal of refuse during inclement weather? If so, how convenient are they?

4. Considering surrounding land use, can the dust and noise which result from normal operations be considered as significant problems along the existing access roads or along any proposed access roads? If significant, would it be practical to resurface the roads, add fencing, oil the roads, or add tree breaks?

5. What is the accessibility (i.e., miles, traveling time) of the land disposal site to well-developed highway systems and railway systems?

CLIMATE

1. Have provisions been made to maintain operations during extended rainy periods?

2. What are the temperature extremes? What are the anticipated quantities of rain or snow, and the frequency of severe storms?

COVER MATERIAL

1. What types and quantities of soil are available at the site for cover material?

2. What types and quantities of soils are available nearby? How far? What are their sources?

Table 17-2
(continued)

WATER POLLUTION

1. Are there any problems, e.g., ponding, scouring, etc., due to improper surface drainage of stormwater runoff? If so, what modifications are required to correct these problems? What are the downstream uses of this water?

2. Is any part of the site located within a flood plain? If so, what return frequency storm would result in flooding of any part of the site? What modifications are required to correct this problem?

3. Is any refuse placed where the ground-water table will come in contact with it? If so, is it practical to resolve this problem? What are the present and programmed uses of the ground water in this area? What are the duration and frequency of the contact period? What is the hardness of the ground water away from the direction of horizontal flow? Is the aquifer of a calcareous nature?

4. What is the bedrock elevation and what type of rock is it?

LAND USE

1. In general, what is the surrounding land use? What is the programmed land use?

2. What is the programmed use for the site once it is filled? Will this use be of significant value to the surrounding community?

3. In general, is suitable land available nearby for expanding the site? If so, how much? How far way?

REMAINING CAPACITY

1. What is the estimated remaining capacity of the site for refuse? This is to be based on definitive operational plans if the site is a sanitary landfill. If not, assume the area method of landfill is to be applied to gully, canyon, ravine, etc., locations and the trench method is to be applied to gently sloping land areas. Then assume for area method landfills that fill will be to a depth no greater than 40 feet (5 levels at 8' each) if that is possible, and assume for trench method landfills that the fill will be to a depth of 8' in trenches 4' deep and 12' wide with a separating ridge width of 3'. The capacity of the site required for filling the existing quantity of refuse must be subtracted from this estimate.

Table 17-2
(continued)

EQUIPMENT

1. What amount and types of major equipment are available at the site?
2. What is the general condition of this equipment and what is the ownership?

FACILITIES

1. In general, what are the existing facilities (weighing facilities, fencing, etc.)?

Figure 17-1

Waste Classification System
Effect on Elements of a Waste Management System

Waste by Classification	Storage	Collection and Transfer	Processing	Handling	Disposal				Post Disposal Problems
					Landfill	Incin.	Compost	Other	
Solid Wastes Putrescible									
Household Garbage	X								
Veg. and Fruit Proc.	XX	X		X					
Animal Manure	X								
Dead Animals	XXX	X	XX	XX	XX	X		XXX	
Meat, Poultry, and Seafood	XX	X	XX	XX	X				
Bulky Combustibles									
Wood		X		X					
Paper and Paper Prod.		X		X					
Cloth		X		X					
Plastics		X	X	X	X	XXX	XX		XX
Rubber		X	XXX	X	X	XX	X		XX
Leather		X	XX	X					
Yard and Street Wastes		X		X					
Bulky Non-Combustibles									
Metal		X	X	X		X	XX		
Mineral		X		X		X	XX		
Small Combustibles									
Wood									
Paper and Paper Prod.									
Cloth									
Leather									
Plastics					X	XX	X		XX
Rubber					X	XX	X		XX
Yard and Street Wastes									
Small Non-Combustibles									

Note: X signifies a minor problem.
XX signifies a moderate problem.
XXX signifies a major problem.

CHAPTER EIGHTEEN

SITE REUSE

INTRODUCTION

Ultimate use of the filled land and the opportunity to achieve this use quickly are as important as the technical and economic aspects of the actual landfill operation. In practice, these major considerations interact: ultimate use guides and constrains the configuration and method of fill; and the characteristics of the resultant filled area significantly influence the range of choice for ultimate use. Therefore, selection of a site, determination of landfill methods, and evaluation of feasible alternatives for ultimate land use must be closely coordinated.

This chapter first presents the broad perspective of site reuse as a frame of reference for reviewing the considerations essential to selection of alternative end uses for any site. Next, these alternatives are reviewed in reference to implementation requirements and related problems. Finally, a case history of a hypothetical site is presented, with a complete program of site development from the original use before the landfill operation through implementation of the ultimate use. Fill operation and phasing of the ultimate use are emphasized as important elements of a properly executed reuse program.

SITE REUSE IN PERSPECTIVE

In the consideration of solid waste disposal, sanitary landfill stands out as the least expensive method available, even when operating practices are refined to conform to the best known procedures. In the development of any Implementation Plan for solid wastes which includes sanitary landfill as an alternative, three factors that must be considered are often forgotten. Even when they are included in the evaluation, they are frequently evaluated on a basis which is not consistent with all aspects of a true planning concept.

The first factor relates to the flexibility of a sanitary landfill with respect to all of the solid wastes generated. Proponents of the sanitary landfill have traditionally ignored many types of waste produced. An "ideal" sanitary landfill will proclaim with pride that one of the measures used to protect the environment is unequivocal rejection of any waste material known to be or suspected of creating problems, and for that matter, any material for which the problems may not be understood. This leaves the rejected materials to be disposed of by a segment of the society which may or may not approach the problem with any degree of care or diligence. Thus, the sanitary landfill is not a total solution, and frequently ignores a fraction of the wastes that is larger than the fraction considered acceptable at the landfill.

The second factor relates to the role of sanitary landfill in combination with other disposal schemes. Some proponents of incineration have referred to this method as "ultimate disposal". This concept is a long way from the truth, and most knowledgeable people in the field of solid waste have long since discarded this term. Incineration and other forms of solid waste disposal produce a residue which is non-combustible or non-degradable, and sanitary landfill is the usual means of disposal of this residue. Attention has been given recently to the recovery of resource materials from refuse and from incinerator residue, both directed primarily at the non-combustible portion. This approach does effectively move the combination of incineration and salvage or recovery more toward an "ultimate disposal", but for some time to come, the land requirement for incinerator residue must be an integral part of an Implementation Plan which considers incineration. This requirement for landfill space necessitates conservation of the land resource for such unavoidable uses.

The third factor is seldom or never discussed, both because it is least understood and because it is difficult to explain to the general public, who must spend the money for the scheme proposed by the "experts".

Sanitary landfill is a destructive use of a natural resource - land.

It is destructive in the sense that once used for sanitary landfill purposes, it is not reusable for that same purpose. The terms "site reuse" and "land reclamation" have become by-words in solid waste disposal, and these concepts are too often improperly used to sell sanitary landfill as a beneficial interim step. In reality, both of the terms really refer to the process of converting land to a more beneficial use, whereas, "reuse" implies the ability to use a resource again for the same or a similar purpose. Sanitary landfill does have a place as a means of achieving land reclamation, but land reclamation does not necessarily justify sanitary landfill.

It is common practice in the Engineering profession to select a design year for proposed facilities at some significant time in the future. This time period is frequently tied to the period of bonded indebtedness for the facilities for which the bonds are sold. This is sound engineering logic, in that a community should build a facility which serves at least as long as it takes to pay for it.

In recent years, the planning function has come more into play, and programs for land use, zoning, utilities, and other elements of a community have been considered with a view well into the future. This has caused long-range planning efforts to consider periods of time as much as 50 years into the future, instead of the 20 to 30 years which was typical of the engineering "design year" concept.

Both of these concepts are sound, as long as they are applied to planning for facilities which may be replaced or modified in the future. It is not appropriate to apply them to destructive or consumptive uses of a resource. The fact that land is available for sanitary landfill for 50 years into the future does not satisfy the question of what happens in year 51. A wastewater treatment plant can be expanded, a rapid transit system can be built to move people from outlying areas, but new land cannot be created.

In the general field of environmental engineering and planning, the sanitary landfill stands alone as the only "modern" approach which defines its own ultimate limits by the very nature of the process. Water may be treated and reused. Air may be cleaned of its contaminants. Metals, glass, and paper have already been recycled into use in actual practice, and even ash has been turned into blocks used in the building industry.

Sanitary landfill must be treated for what it is - an interim solution, even if the interim period extends for as long as 50 years. A true plan concept cannot and must not be content to consider this approach as a viable long-term alternative, for in so doing, it only defers to and compounds the problem of future generations.

REUSE FACTORS AND CONSIDERATIONS

Where sanitary landfill has been determined to be a logical means of achieving a land reclamation program, there are still many factors which must be considered to ensure both a proper operation and maximum benefit from the ultimate use. These factors include: existing land use; geology; hydrology, topography, and soil cover of existing sites desired ultimate use for the site; interim use of the site; operations (including phasing) of the landfill itself; transportation access to and within the site; and the economics of the landfill operation and of the ultimate land use. The following discussions focus on the impact of each of these factors on definition, planning, and implementation of any alternative ultimate use for a landfill site.

EXISTING AND FUTURE LAND USE

Existing and future land use of the site and in the surrounding region are extremely important in determining the potential of a given landfill site. Important considerations are the compatibility of alternative ultimate uses with immediately adjacent uses and the demand or need for proposed uses in view of growth and activity in the surrounding region. For example, it may not be wise to propose a recreation facility in an area where a major regional recreational facility already exists within a few miles of the site. Further, it would not be wise to consider industrial activity in a site that is far removed from related markets, necessary transportation, etc. Part of the existing and future land use consideration is that of zoning; full assurance should be made that the proposed use for the filled land does not conflict with existing or proposed zoning requirements for the area.

GEOLOGY, HYDROLOGY, TOPOGRAPHY, AND SOILS

The geology, hydrology, and topography of a site have a strong impact both on the landfill operation itself and on the choices available for potential land use. In a site where there is great depth to bedrock, it may not be feasible to consider heavy construction which would require expensive pilings, although this site might otherwise be appropriate for landfill activity in that sufficient depth between cover and bottom of lowest cell would preclude any operating problems. The topography of the site is important (both as it exists and as it may be shaped by the landfill operation) to assure adequate safe drainage of surface and subsurface waters and to allow redistribution of land for proper fill and compaction. Hydrology of a site is important both in operation and in ultimate use to ensure that the natural water flow and water table in a given site will not be disturbed. The availability of proper soils, both for redistributing cover material in the landfill operation and for providing suitable building soils for ultimate construction (or other use), is also important in a reuse definition.

DESIRED ULTIMATE USE

The desired ultimate use itself has an impact on the landfill operation. Consideration of the demands of a proposed reuse such as roadways, parking, structural requirements, phasing, and construction costs must be taken into account when viewed with relation to the proposed operation of the fill. Planning for the ultimate use must take into account consideration of flexibility and change, because demand for activity may change in the surrounding area and region. To lock fully into one specific use without allowing the capability of accepting additional uses on a site could preclude the best long-range mix of uses for a site to serve the community, surrounding area, and region.

OTHER FACTORS

Other factors which are important in planning for and implementing a landfill operation include any proposed interim uses. Consideration of the feasibility of using filled land for some other purpose before it is ready for the ultimate use may be an important factor in some cases. Operations and phasing of the site are linked with interim use and ultimate use in that appropriate amounts and conditions of land must be available in a reasonable length of time to allow final construction or other desired ultimate activity to be undertaken. Transportation to, from, and within the site is important in allowing smooth and economic flow of waste materials to the site, disposal on the site, and the flow of service vehicles from the site. Transportation must also be considered in light of the demands and needs of the ultimate uses such as rail for industry, or major highways for dense residential development. Finally, the economics of the landfill operation and the resultant value of the land at the ultimate-use activity level must be considered in light of tax return as a discount against the cost of capital investment and operations during the life of the landfill. Proper selection of ultimate use can often provide a significant repayment to the municipality in which the landfill operation is located, by virtue of the increased tax return on the developed property.

ULTIMATE USE ALTERNATIVES

Alternatives for ultimate use of a sanitary landfill site are relatively broad; however, there are certain restrictions as to weight and type of construction which may take place on a landfilled area. These restrictions frequently can be overcome by proper engineering, although in many cases the required engineering may be quite involved. Proposed use of areas of undisturbed earth adjacent to the actual fill areas is a factor in considering each potential use. The use of a site may be restricted by its surroundings, and to some extent by the amount of settlement in the fill. A fill several miles from a residential district is not a desirable site for a playground or parking area, and the fill that can be expected to settle rapidly and unevenly is not suitable for even light construction. Throughout the United States many uses have been made of landfill sites, including: recreation; residential; commercial; industrial; and other uses such as airports, parking areas and even stables. The following discussion touches briefly on the examples and constraints of uses in various sections of the United States. The examples were generally drawn from an article, "How to Use Your Completed Landfill" in the August 1965 issue of *The American City*. A 1966 American Public

Works Association publication, "Municipal Refuse Disposal", was the principal basis for discussion of construction details on landfill sites and of measures for coping with escaping gases.

RECREATION

Parks, playgrounds, and ball fields are the most popular uses for landfill sites. Two feet of well-compacted final cover is generally sufficient for most parks and playgrounds. If trees or large shrubs are to be planted, a deeper final cover may be necessary to provide sufficient soil depth for root growth. Special provisions will be necessary to remove methane gas from areas that are to heavily landscaped, because methane gas will damage the roots of most plants. Typical recreation uses of completed landfills include parks, golf courses, riding, and general recreation areas. Many of the major cities in the United States have at some time used landfill area for a park site. Special recreation uses have included development of a ski slope by contouring and working the fill in lifts in Virginia Beach.

RESIDENTIAL

Residential projects have been constructed on existing landfill sites. New York City has a substantial number of housing units built on landfill sites. The Eastwick Project in the City of Philadelphia is constructed on a landfill site. Both single-family and multi-family uses have also been completed in Grand Rapids, Michigan; Charlotte, North Carolina; St. Louis Park, Minnesota; Richmond, Virginia; and Dallas, Texas.

If construction is carried out over a filled area, pilings or deep-cut, spread-footing foundation walls should be used. Special techniques including capping and venting should be used to disperse methane gas to areas as far removed as possible from proposed housing projects. Techniques for handling subsurface gases include: the intercepting and dissipating by means of suitably-designed, porous, gravel-filled trenches or by pipes inserted into the body of the fill; confining the gas by means of subsurface enclosing envelopes of gas-tight construction. Generally, no service basements, crawl spaces, or similar open spaces should be permitted below finish grade. The ground floor should be at least one foot above finish grade and should be of permanently gas-tight construction; the fill immediately beneath the structure should be of non-porous materials to a depth of 24". All pipes, ducts, and conduits piercing the ground floor should have gas-tight gaskets of an improved permanent nature. For multiple dwellings, a three-foot high, permanently-ventilated crawl space above finish grade is recommended under the area of the entire building. The crawl space itself should have gas-tight floor construction at the top and an impervious slab at the bottom. Where structures are to have a basement or a cellar, there are techniques to provide a gas-tight enclosed area.

COMMERCIAL

Commercial buildings and shopping centers have been developed in a number of cities including Nashua, New Hampshire; Belmont, Texas; Seattle, Washington; and Philadelphia, Pennsylvania. As was the case in multiple dwellings of lightweight construction, care must be taken to capture and/or divert methane gas away from the structures by providing gas-tight construction. Good compaction is required to minimize settling and, therefore, structural faults. The most successful sites have reserved a tract of undisturbed earth for the construction of major buildings or have used pilings where heavy construction was involved over fill areas.

INDUSTRIAL

Industrial projects have been built in Dallas and Beaumont, Texas; San Diego and Burbank, Claifornia; Davenport, Iowa; and Philadelphia, Pennsylvania. These range from lightweight, double-frame construction to buildings using 80-foot piles driven to refusal. Another technique used for heavy construction of industrial activities involved excavation through the landfill area to base level, with accompanying special treatment of the exposed waste to prevent putrification and the spread of noxious odor. Again, the problems of gas removal and settling must be carefully watched, and planning for undisturbed earth for construction of major buildings is generally the route which has provided the greatest success with minimum problems.

OTHER USES

A number of cities have found other uses for completed landfill sites or have combined uses on a single site. Major reuses include: airports such as La Guardia Field in New York City; and an extension of runways as in the case of Morgantown, West Virginia. In both instances, compaction was a critical factor in order to withstand the heavy impact loadings provided by the landing and taking off of aircraft.

Other special uses include light-duty outdoor operations such as parking areas and handling or goods-transfer yards. In these cases, the paving that is used must be flexible and generally must have a bitûminous binder to allow for any sub-settling which may take place. The City of Seattle, Washington used one site for the University Field House. This was a reasonable reuse because of the overall light-duty construction and the provision for free escape of methane gas from below the surface. The World's Fair site, well known in the New York City area, is constructed over a landfill. An unusual reuse is illustrated by the construction of a hospital using pilings for the main support in Cincinnati, Ohio. Also, one of the few landfill reuses of its type is the Mill Creek Water Commission Control Plant in the same city.

ILLUSTRATION OF SITE REUSE

Based on the information presented above, virtually any reuse is feasible so long as proper planning, landfill operations, and construction techniques are carried out. To better illustrate the potential for site reuse in New York State, a hypothetical site was developed which incorporated natural surface and subsurface features of existing landfill sites. Conditions with regard to site features, surrounding land uses, proximity to major highways and rail lines, and distance from a major urban center were based on typical situations in the State. The following sections present an example based on development in the region to be served, a description of the typical site, the concept of the proposed reuse, landfill operations and phasing of the reuse, and the ultimate reuse development plan. Details as to site and development characteristics, operations and fill methods, and ultimate site preparation and drainage are also discussed. This presentation is intended to serve as a guide in the planning, effectuation, and final development of a landfill site reuse program.

REGIONAL LOCATION AND DEVELOPMENT

As shown on Map 24, the hypothetical site is located approximately fourteen miles from the center of a major city. An interstate highway runs east-west fourteen miles north of the site, and one of the two major rail lines is less than four miles to the west of the site. A two-lane primary State highway provides access to the site from an existing major highway and expressway network servicing the urban growth areas. Growth within the city has ceased and expansion into suburbs and rural areas is progressing at a rapid pace. Small clusters of development on larger lots are already taking place near the site. Increased development is projected to take place in the area of the site within the next ten years.

To provide smooth, efficient access to the site and support projected development, highway and rail improvements will be required. The "cross-town expressway" must be extended east to the north-south State primary highway. The State primary, now two lanes, must be improved and widened to four lanes south from the "cross-town expressway" to the site area. A major, heavy road-bed spur track must be extended from the existing rail line eastward into the site, and a tipple siding constructed on the site. At two points on the spur, passing or blocking sidings will be required to allow sequencing of the loaded cars and to maintain a smooth flow for unloading of waste.

THE EXISTING SITE

The site is approximately 600 acres in area and has a soil consisting mainly of glacial till with other soils which vary from gravelly fine sand to silt loam. Four hills dominate the site with slopes in excess of 15 percent; however, most of the site is gently sloped and rolls to a moderate level. Deciduous hardwood trees and some evergreens cover approximately 20 percent of the site, and a major creek, with an impoundment, flows through the southwestern portion of the area. The site is moderately well drained; depth to water table varies from 12 to 15 feet, and depth to bedrock is greater than 50 feet at minimum level. Sufficient cover material is available on the site for most of the landfill operation.

Present land use activity on the site includes grain and cover crops on approximately 50 percent of the site area, and a one-acre lot, one-family subdivision in the southeast corner of the site. The site is bounded on the west by the two-lane State primary roadway (which is to be improved to four lanes) and on the north, east, and south by two-lane State secondary highways. The general surroundings include a mixture of large-lot, one-family developments and active farms. Zoning in the area allows for one-family housing, with agriculture as a permitted use. A Planned Unit Development Ordinance is in effect in the municipality, allowing a mix of land uses on tracts meeting minimum specifications.

Map 25 illustrates the existing conditions on and adjacent to the site. This map also delineates the various assumptions and constraints imposed on the site after an analysis of existing conditions. Minimum setbacks from adjacent roads, watercourses, and existing residential areas are established. Locations most suitable for sanitary fill, cover material removal, and for required buffer planting, screening, and berms are indicated. Areas of undisturbed earth as well as areas of cut and fill requiring normal stabilization are also shown as locations for possible construction. Finally, the phasing of the fill operation and reuse development are shown by general areas for selected target years.

CONCEPT OF PROPOSED REUSE

The reuse proposed for the 600-acre site is a Planned Unit Development. This plan was chosen on the basis of projected regional growth into the are and the compatibility of existing site conditions with the requirements of various land use activities. A mixture of several residential structure types at different densities, a small commercial facility, and light industrial activity and recreation areas are suggested in those areas of the site for which they are best suited. This placement recognizes the inherent constraints of building on fill areas, on areas of cut and fill, and on undisturbed earth. The location of the industrial and commercial facilities also takes into account the proximity to and type of adjacent land uses, as well as the requirements for access from points outside the site.

Campus-like industrial activities are included because a spur for rail haul would already exist, and an improved State primary on the west side of the site would provide necessary access while allowing a separation of the service-type area from residential and commercial areas. Commercial uses are proposed to serve the needs of the current and future residents of the site and surrounding area. A variety of residential unit types and densities are suggested to make best use of the amenities of the site, to assure market coverage, and to allow a natural phasing of development. Finally, recreation to meet the needs of the area residents is recommended as the most practical use over actual fill areas.

OPERATIONS AND PHASING

The potential success of any proposed reuse is a direct function of the quality, the control, and the filling techniques used in the operation of the landfill and surrounding site development. A landfill operations plan and phasing program was designed based on the information describing the existing site, the goals and proposals of the ultimate reuse proposed, and high standards of sanitary landfill implementation. The proposed operation in its various stages and phases of development is shown in Maps 26 through 29.

OPERATIONS

There are many methods of operating a sanitary landfill. The methods to be used on this site are the trench, area, and valley fill methods, depending upon the topography and final use. The trench method has the advantage of providing a more direct means of dumping control which is not always possible with the area method. Since a specific place is designated for dumping, the scattering of refuse by the wind is minimized and refuse trucks can be readily directed to the trench. The area method is more suitable for level ground. Here sufficient cover material will be stripped and stockpiled to meet the total need for earth cover or, if this is not possible, earth will be hauled in. In all cases, refuse will be spread and compacted in 12-inch layers as dumped, and promptly covered. The spreading and compaction will take place on a working face which has a 30-percent slope.

The trench method will be used primarily on level ground, although it is also suitable for moderately sloping ground. In this method, a trench is constructed by making a shallow excavation and using this excavated material to form a ramp above the original ground. Refuse is then methodically placed in the excavated area, compacted, and covered with suitable material at the end of the day's operation. Earth for cover material may be obtained from hillsides or from the area where the next day's refuse will be placed. Trenches will be made 20 to 25 feet wide, and the depth of fill will be determined by the established finished grade and by the depth to ground water or rock. Wherever trenches can be deeper, more efficient use can be made of the available land area.

The area method will be utilized on fairly flat and rolling terrain by using the existing natural slope of the land. The width and length of the fill slope will depend on the nature of the terrain, on the volume of refuse delivered daily to the site, and on the approximate number of trucks that will unload at the site at one time. Side slopes will be of a 30 percent grade, while width of fill strips and surface grades will be controlled during operation by means of line poles and grade stakes. The working face should be kept as small as practical to take advantage of truck compaction, to restrict dumping to a limited area, and to avoid scattering of debris. In the ramp method, earth cover will be scraped from the base of the ramp. In the area method, cover material will be hauled in from a nearby stockpile or from some other source.

In valleys and draws, the area method is usually the best method of operation. In those areas where the valley is deep, the refuse will be placed in "lifts" from the bottom up with a depth of six to ten feet, although greater depths may also be used. Cover material will be obtained from the sides of the valley. The first layer will be constructed for a relatively short distance from the head of the valley across its width. The length of this initial lift will be determined to allow for initial settlement. Succeeding lifts will be constructed by trucking refuse over the first lift to the head of the valley. When the final grade has been reached (with allowance for settlement), the lower lift will be extended and the process repeated.

Care will be taken to avoid pollution of both surface and ground waters. This will be done by intercepting and diverting ground water away from the fill area or by directing its flow through pipes of suitable size. Special provision will also be made for temporary surface water drainage and runoff to prevent erosion, washout of refuse, and contact of surface water with the filled area. In some cases, it may be practical to provide a diversion ditch to carry most of the runoff away from the fill area. In other cases, it may be necessary to line the sides and bottom of the area perimeter with a layer of coarse gravel or other permeable material, to allow ground water and runoff to drain without contact with the refuse. As with other fill methods, grading during operations will be implemented, to avoid ponding on the surface or seepage into the completed lifts. As areas are filled, methane-collecting impervious material with stone-lined vents would be provided.

To ensure proper control once the major fill areas are in operation, full perimeter fencing with a weigh station at the entry road should be provided. Offices, restrooms, showers, and rest facilities will be provided for the site employees. A lightweight equipment-storage structure would also be built in this area. It is expected that a full complement of equipment including several wheeled front end loaders, bulldozers, and landfill compactors will be required. At least one earth mover, one motor grader, a drag line, and possibly a clam scoop shovel will also be required for fill operations and site redevelopment. As rail haul of refuse becomes feasible, a spur will be extended on a heavy bed into the site. Hopper and tipple cars will be used to transport waste onto the site. An enclosed tipple and bin complex would be constructed at a mid-point in the major fill area to allow rail cars to be emptied as they arrive and to be moved away soon after. Twelve- to fourteen-cubic-yard trucks can move the waste from the bins to the current fill area. These trucks can also be used to move cover material across the site or from areas outside of the site.

PHASING

It is proposed that a fill operation receiving wastes delivered only by truck be started in the northeast corner of the 600-acre site in 1970. The site area south of the creek would be placed in development for recreation uses such as ball fields and tennis courts, with picnic areas near the creek; regrading to create berms as visual barriers would be implemented. Landscaping and screening would be started to protect the residential development in the southeast corner of the site.

Between 1970 and 1975, extension of the rail spur, construction of rail car tipple and access road, and industrial site development would begin. Where necessary, regrading will be carried out to shape the site as required for these activities and to provide an initial stockpile of cove material. In those areas not intended for immediate use as fill or cover materials areas, existing agricultural activity would be allowed to continue. Recreation development south of the creek should be nearing completion. As landscaping is required, fresh vegetation and trees will be imported from off-site locations, because the relative cost of moving on-site landscape vegetation is generally not competitive.

By 1975, the first fill area is to be completed and will remain undeveloped for at least one year to allow for initial settlement. Additional soil fill material will then be added and compacted. The first of the two major fill areas (Fill Area No. Two) will then be in operation, with the expectation that a major portion of the waste material will be arriving by rail haul. Valleys and draws will be filled first, proceeding south into the flatter areas, where trench and area fill methods will be used. By 1980, the industrial area should be in use, residential construction should be underway in the eastern part of the site on undisturbed land, and the first construction phase of the commercial facilities should be in progress.

Between 1980 and 1990, Fill Area No. Two should be completed and Fill Area No. Three placed into operation. By this time, most of the residential areas should be under development, the commercial complex should be completed, and the first nine holes of an eighteen-hole pitch and putt golf course can be started over Fill Area No. Two. Small play areas, hiking and riding trails, and possibly picnic areas can be integrated with the golf course development.

It is expected that by 1990, Fill Area No. Three will be finished or nearing completion. The remaining nine holes of the golf course can be completed. Residential development will continue until completion of the ultimate plan. Final landscaping and grading will be carried out to remove all indications of the fill operation. Unneeded sections of the rail spur and the off-loading tipple installation would be removed. What was a temporary site access road will be improved as the final section of the internal circulation plan.

ULTIMATE REUSE PLAN

The ultimate development plan as proposed for the 600 acres is shown on Map 30. If developed according to this plan, the site would provide a commercial complex, industrial development, a variety of residential unit types, and recreation facilities.

The commercial complex is located on a 25-acre site which includes all associated land uses such as parking, service, pedestrian malls, and buildings. It is envisioned that this would be a commercial complex of substantial proportions, supporting both local and surrounding area residents. Access would be provided by means of a service road connecting the site to the State secondary highway along the southern edge of the site, thus avoiding dangerous ingress and egress directly onto a highway.

The industrial development, intended principally for light industry, goods handling, and research or office activities, is provided with rail access at the rear and restricted road access at the front of the properties. Parcels of land range from some three to eight acres, with the potential for subdividing the larger parcels. The access road is planned with a 60 foot right-of way and a 32- to 36-foot paved cartway. This access road would also provide service access to the rear of the commercial facilities and allow separation of delivery vehicles from shopper traffic.

A variety of housing types including townhouses, apartments, and one-family homes is recommended for the residential area. These types would be mixed and clustered to provide for a wide range of choice to allow creative siting during actual development, to take full advantage of existing and created site topography, and to provide landscaping and pedestrian pathways separated from roads. Road access into the residential areas is proposed at one point on each of the four boundary roadways. A minimum right-of-way of 50 feet and a minimum paved cartway of 26 feet are recommended as residential roadway standards. Where roads and parking areas cross or are located on areas filled with waste, a flexible paving material with bituminous binder is recommended.

A variety of recreation facilities are suggested. Riding trails, picnic areas, active play fields, and an eighteen-hole pitch and putt course are proposed over Fill Areas Two and Three in the center of the site. South of the creek, active play fields, picnic areas, and a swimming pool are recommended. Seasonal uses on a small scale could take place on the lake. Parking areas with direct access from the highway on the south are provided. Improved drainage ways are shown as necessary to collect and channel surface runoff into the creek.

The plan shown is indicative of the final use of a landfill site where careful pre-planning and fill operation have been implemented. There is no requirement that the complete range of land uses shown here should be developed. However, their inclusion is feasible where proper procedures of fill methods, site development, grading, and landscaping are employed, and where demand for such uses exists.

CHAPTER NINETEEN

SERVICE AREAS

INTRODUCTION

In New York State, there are essentially no regional solid waste disposal operations. Through the State, there are many small dumps serving one or two small towns unable or unwilling to afford the cost associated with sanitary disposal. Expensive incinerators have had to be constructed when rapidly-developing municipalities were unable to come up with a landfill site and the enveloping municipalities were either in the same position or refused to accept the waste. However, even these incinerators were developed as local rather than regional operations. Only ten of the 77 municipal incinerators in the State serve more than one municipality, and only two of the ten have capacities greater than 200 tons per day.

The aesthetic problems, the air and water pollution, the possible health hazards, and the magnitude of the public costs associated with disposal in this fashion certainly indicate that a different approach is needed.

ADVANTAGES OF A REGIONAL APPROACH

Recent study and analysis of waste management suggest that it is desirable to establish regional means of handling and disposing of wastes on a broad, systematic basis: Some of the advantages of regional area-wide solid waste management are:

1. It makes possible a comprehensive study of the total area generating the solid wastes, and facilitates consideration of area-wide solutions of common problems, both on short-term and long-term bases. An effective study which considers local problems can also help overcome the mutual distrust that often hampers joint operations among adjoining municipalities.

2. There is usually no more objection to one large regional operation than to an individual town (or village or city) operation. Coordinated effort can therefore be directed to overcoming the objections to one site and operation, rather than to each of several town, village, and/or city sites.

3. The unit cost for the disposal of a large volume of solid waste is less. Duplication of engineering, overhead, equipment, labor, and supervision is eliminated. For example, the annual cost of refuse disposal by sanitary landfill for a community of 50,000 would run around $1.50 per capita ($1.85 per ton). For a community of 450,000, the cost would run around $1.00 per capita ($1.25 per ton). Incineration cost for the same example would range from $7.00 per capita ($8.75 per ton) for the smaller community, to $3.95 ($5.00 per ton) for the larger community.

4. Better operation is possible with area-wide service, because adequate funds for proper supervision, equipment, and maintenance can be more easily provided. A properly qualified superintendent can run a large operation as easily (or more easily) than a small one, and the shortage of people with these qualifications reinforces the practical advantage of a centralized operation.

5. Site selection may be more effective on a regional basis, because more land areas would be available for consideration. A local government or authority may be forced to resort to the more costly method of incineration simply because suitable landfill sites may not be available within or near the municipality.

6. County or regional financing costs for solid waste disposal are often less, because a lower interest rate can usually be obtained on bonds because of the broader tax base.

Most of these advantages are widely recognized, but regionalization has been hampered by the inability to get adjoining municipalities to cooperate with each other. A trend toward regionalization is evident in New York State, as evidenced by inter-municipal cooperation in various programs, such as education. However, if regional solid waste systems are to be implemented within a reasonable time, it is apparent that the New York State Government will have to assume responsibility for promoting and prompting them. This implies the further responsibility of analysis of the factors which affect creation of a regional system in order to define those geographical areas which should logically be engaged in cooperative efforts.

The term "Region" has several popular connotations already in use across the country, as well as in New York. A region may be defined because of past cooperative efforts, by a Planning Agency and its geographical scope, or even by the Standard Metropolitan Statistical Areas defined by the Bureau of the Census. An existing "Region" may have been devised for purposes totally disconnected with the problem of solid waste handling and disposal, and therefore may not be applicable or appropriate in establishing solid waste regions.

To avoid confusion with existing regions or regional efforts, the term "Service Areas" has been chosen to represent a portion of New York State for which cooperative solid waste efforts are appropriate and should be promoted. A service area is characterized by:

1. The geographical boundaries within which the system functions.
2. The location and size of appropriate sites and facilities within its boundaries.
3. The quality of the operation of the facilities.
4. The quality of the service involved in collecting wastes at their sources.
5. The distribution of wastes from their sources to the facilities.
6. The responsibilities, powers, and authorities of the management agency or agencies within the service area.

CRITERIA FOR SERVICE AREA DEFINITION

The major objective in defining a Service Area must be to realize the least cost with the most manageable and effective disposal means. Because each of the elements of a service area can differ greatly, there is an extremely wide variety of alternative measures available for the disposal of solid waste in New York State. Selecting from these alternatives is a most complex task because the selection must consider not only costs, but also the political, institutional, technological, aesthetic, and social issues which are closely interrelated. The delineation of service areas must be directed toward meeting future demands. In the interim, it may be economically feasible or politically desirable to develop cooperative efforts on only a "sub-service area" scale. Such efforts should be encouraged provided they represent an effective approach either in themselves or as a step toward the ultimate service area solution.

The task of defining a service area is clearly in the realm of systems analysis, which is concerned with pointing out promising alternatives and describing the economic and technological consequences of each in quantitative terms to provide a basis for decision-making. The most effective means of developing this decision-making basis is to formulate the relevant variables in a mathematical model programmed to minimize the cost of refuse disposal in New York State. Application of such a model could determine optimum location and size of facilities, communities to be served by these facilities, and the best means of moving the waste to these facilities. If this is done effectively, the solution of the model will implicitly define proper service area boundaries.

Such a mathematical model has been proposed for development in subsequent phases of the New York State planning effort. However, some indication of potential service area boundaries was desired at this stage of study. Regardless of any difference in the amount of study or detail used to develop the Service Areas, the criteria for selection must be the same. These criteria are:

1. A service area must be a contiguous geographical area, which to the greatest extent possible approximates a square or circle in shape so as to minimize travel from the center to its most remote points.

2. Wherever undue distortion of technical or economic considerations will not occur, boundaries should be coterminous with existing county lines, to minimize the extent and complexity of political and legal considerations.

3. The method of dealing with the solid waste problems should be compatible within a Service Area, in that a single management approach (and hopefully, a single technical approach) can apply over the entire area.

4. Physical, economic, and political features of the component parts of the area should be compatible.

5. High-density waste producing centers should generally not be located at or near the boundaries of a Service Area, where the resulting ton-miles of refuse haul tends to be near maximum.

6. All solid waste generated within a Service Area should be disposed of within the Service Area. Where this is impractical on a short- or long-term basis, arrangements may be made between Service Areas.

7. Although the intent is to divide the entire State into Service Areas, a Service Area does not have to be defined for any portion of the State for which inter-governmental cooperation produces no benefit.

DELINEATION OF SERVICE AREAS

Boundary definition is best accomplished by solution of an appropriate mathematical model; however, the criteria developed in the preceding section provide sufficient direction for an illustrative delineation of service areas in New York State. The only data needed for tentative selection of service areas are those defining the waste density throughout the State. This has been developed in previous Chapters and is available for municipal, agricultural, and industrial solid waste classes.

It is reasonable to assume that on-site disposal of most agricultural wastes (with perhaps the exception of chicken and duck manure in certain localities) will continue to be an acceptable practice, and consequently agricultural wastes as a separate class will not have any significant impact on the service area definition for several years to come. This is obviously not true for municipal and industrial waste; it is likely that service area operations will be concerned with providing disposal for most industrial waste as well as all municipal waste. In this sense, the data most appropriate for delineation of service areas are the waste densities for municipal plus industrial wastes.

The concept of service areas is directed to the needs of the future; therefore, the service area delineations should be based on future quantities of wastes. These data for the years 1975, 1985, and 1995 were developed and have been presented in Chapters Thirteen and Fourteen.

The methodology used to make the illustrative delineation of service areas was as follows:

1. Use the criteria developed in the previous section and 1995 municipal-plus-industrial waste density data to define service areas appropriate for that horizon year.

2. Use 1985 waste density data to divide, if appropriate, the 1995 service areas into sub-service areas.

The selected service areas are shown superimposed over the 1995 municipal-plus-industrial waste density map in Map 31, which was developed from Map 17 by omitting the two lowest waste density levels; in this example, the service area boundaries follow the existing county lines. However, in all cases, political county boundaries cannot necessarily be expected to be compatible with service area boundaries. For example, Herkimer County in

Central New York State is a long, narrow county (90 miles by 20 miles) with the northern portion lying in the Adirondack Forest Preserve and the lower portion within the Mohawk Valley corridor of growth and development. While it is readily apparent that the service areas boundaries will not conform to county lines, it is not possible to establish the exact boundary lines without using the mathematical model. Similarly, the selected sub-service areas are shown in Map 32, which is derived from the 1985 municipal and industrial waste density data of Map 16. This series of Maps (31, 32 and 33, which is a comparable derivation of the 1970 data of Map 15) are presented to highlight the density of waste development pertinent to Service Area delineation.

Table 19-1 is a listing of the counties in each of the six service areas. Because of low density of expected wastes, large-scale cooperative efforts are not warranted in the northern and southwestern part of New York State, and thus counties in these regions are not considered to constitute service areas, and solid waste disposal on a local or county basis would be appropriate there.

FUTURE IMPACT OF SOLID WASTES

Dividing the State into areas such as these does permit general observations to be made. The future demands of solid waste disposal can be indicated by region. Table 19-2 lists the land area requirements (based on 10,000 tons per acre and a fill depth of 8 feet) by service areas and regions, based on all projected municipal and industrial wastes being disposed of solely by sanitary landfill. The information indicates that more than 80,000 acres of land would be required during the 25-year period from 1970-1995 if current landfill practices are used and if all municipal and industrial wastes were to be disposed of on sanitary landfills. To further illustrate the impact on land resources, if all municipal and industrial wastes were incinerated and the typical weight reduction of 75 percent were achieved, the 1970-1995 land requirements would still be more than 20,000 acres. This is a significant amount, particularly in view of the report that only 16,385 acres were devoted to land disposal of solid waste in 1968, of which only 7,627 acres had a life expectancy of more than 10 years (See Tables 12-2 and 12-3).

Another result desired from this study was an estimation of costs for solid waste disposal. Tables 19-3 and 19-4 are listings of the operating costs involved in the disposal of future solid wastes via sanitary landfill and incineration, respectively. It should be noted that these tables do not include collection costs, which can (based on current practices) be more than five times the cost per ton for sanitary landfill. From this information, disposal of projected municipal and industrial wastes during the 25-year period from to 1995 is estimated to cost $1,039,000,000 if all solid waste disposal is by sanitary landfill, and $4,204,000,000 if all solid waste is disposed of via incinerators. Actual costs should be between these two values because combinations of landfills and incineration will probably be used. In any event, it is apparent that solid waste disposal will have a significant financial impact.

The above data on costs and area requirements were determined by multiplying anticipated waste production in the service areas by typical unit cost values ($5.00 per ton for incineration, $1.25 per ton for landfill) and unit land consumption (10,000 tons per acre assuming a fill depth of 8 feet). These unit values were not derived from available New York State data, for reasons explained in previous chapters. However, the information represents average values obtained from current practices and are valid for illustration of the impact of solid wastes.

In 1965, communities in New York State spent $174,200,000 for refuse collection and disposal, for a per capita cost of $10.38. These were based on 960 out of a total of 1,547 cities, towns, and villages reporting, and included only the payments made by municipalities (payments made by individuals to contract operations were excluded from the data calculations).[1] A subsequent Special Report on Municipal Affairs, submitted by the Comptroller of the State of New York to the State Legislature on March 29, 1967 indicated that the solid waste problem is rapidly becoming a major fiscal problem because collection and disposal costs had increased by 150-200 percent between 1955 and 1965.

Realizing the future problems posed by the decreasing availability of suitable land for sanitary landfills, the Bureau of Solid Wastes Engineering and Community Environmental Health conducted a study to locate State-owned lands which could be considered for landfill use. State-owned lands were used in this analysis of the land requirement-availability problem; however, they were used for illustration only, and this discussion must not be interpreted as any guarantee of their availability, even though they are not subject to the legislative constraints that would affect privately-owned lands. Once a complete listing of State properties was obtained, a systematic procedure was used to eliminate those properties which appeared to be unsuitable for sanitary landfill sites. The considerations used to select properties were: size, topography, present land use, and proximity to mass transportation. Table 19-5 is a listing of the selected State-owned lands, and Map 34, with sites numbered to key in to Table 19-5, shows their location.

[1] 1965 Refuse Cost Data, compiled by the Bureau of Solid Wastes Engineering and Community Environmental Health from records of the Department of Audit and Control, Division of Research.

The total acreage of State-owned lands in each service area is presented in Table 19-6, along with the percentage required if all wastes were disposed of by sanitary landfills on State-owned lands. The projected requirement for 27 percent of the selected State-owned lands may seem insignificant however, since many of these lands are already being used for activities high in public interest (wildlife management, recreation), the figure of 27 percent may actually represent essentially all the potentially available State-owned land.

The previous information on costs, landfill acreage requirements, and requirements for State-owned lands certainly indicates that solid wastes will have a significant impact. The firm basis for effective, economical waste management practices inherent in regionalization suggests that the concept of service areas should be promoted to the fullest extent possible.

Table 19-1

Service Areas

Northern Region*

County

- Clinton
- Essex
- Frnaklin
- Hamilton
- Jefferson
- Lewis
- St. Lawrence
- Warren
- Washington

Buffalo-Rochester Service Area

County

- Erie
- Genesee
- Niagara
- Wyoming
- Livingston
- Monroe
- Ontario
- Orleans
- Wayne

Central State Service Area

County

- Cayuga
- Cortland
- Madison
- Onondaga
- Oswego
- Seneca
- Tompkins
- Herkimer
- Oneida
- Broome
- Chenango
- Delaware
- Otsego
- Tioga

Hudson Valley Service Area

County

- Fulton
- Montgomery
- Schoharie
- Albany
- Rensselaer
- Saratoga
- Schenectady
- Columbia
- Dutchess
- Greene
- Orange
- Putnam
- Sullivan
- Ulster

Southwestern Region*

County

- Allegany
- Cattaraugus
- Chatauqua
- Chemung
- Schuyler
- Steuben
- Yates

Lower Hudson Service Area

County

- Rockland West
- Westchester

New York City Service Area

County

- Bronx
- Kings
- New York (Man.)
- Queens
- Richmond

Long Island Service Area

County

- Nassau
- Suffolk

*Not a service area.

Table 19-2

Acreage Requirements to Dispose of Future Municipal and Industrial Solid Wastes By Sanitary Landfill[1]

Service Area	Area Required, acres[2]				
	1970-1975	1975-1985	1985-1995	1970-1985	1970-1995
Northern Region	400	900	1,300	1,200	2,500
Buffalo-Rochester Service Area	1,900	4,800	7,200	6,700	13,900
Central State Service Area	1,000	2,800	4,600	3,800	8,400
Hudson Valley Service Area	900	2,500	3,900	3,400	7,300
Southwestern Region	300	900	1,400	1,300	2,700
Lower Hudson Service Area	600	1,800	2,700	2,400	5,100
New York City Service Area	4,200	11,700	16,300	15,900	32,200
Long Island Service Area	1,500	3,900	6,700	5,400	12,100
	10,800	29,300	44,100	40,100	84,200

---

[1] Consultant's Analysis.

[2] Based on 10,000 tons/acre at 8-ft. depth.

Table 19-3

Total Operating Costs to Dispose of Future Municipal and Industrial Solid Wastes By Sanitary Landfill[1]

Service Area	Disposal Costs, millions of dollars				
	1970-1975	1975-1985	1985-1995	1970-1985	1970-1995
Northern Region	4	10	14	14	28
Buffalo-Rochester Service Area	24	60	89	84	173
Central State Service Area	12	35	57	47	104
Hudson Valley Service Area	11	31	48	42	90
Southwestern Region	4	11	18	15	33
Lower Hudson Service Area	8	22	33	30	63
New York City Service Area	52	145	202	197	399
Long Island Service Area	18	48	83	66	149
	133	362	544	495	1,039

[1] Consultant's Analysis.

Table 19-4

Total Operating Costs to Dispose of Future Municipal and Industrial Solid Wastes By Incineration[1]

Service Area	Disposal Costs, millions of dollars				
	1970-1975	1975-1985	1985-1995	1970-1985	1970-1995
Northern Region	16	42	65	58	123
Buffalo-Rochester Service Area	95	242	358	337	695
Central State Service Area	50	140	230	190	420
Hudson Valley Service Area	44	123	195	167	362
Southwestern Region	17	46	72	63	135
Lower Hudson Service Area	32	89	135	121	256
New York City Service Area	210	585	815	795	1,610
Long Island Service Area	72	195	336	267	603
	536	1,462	2,206	1,998	4,204

[1] Consultant's Analysis.

Table 19-5

Selected State Owned Lands - 200 or More Acres[1]

Site No.	Site	Location[2]	Distance to R.R. miles	Total Area acres	Owner (State Agency)
		Albany County			
1	Partridge Run Game Management	Berne (T)	———	4,680	Conservation
2	Crystal Lake	Rensselaerville (U)	———	7,000	Conservation
		Allegany County			
1	Hanging Bog Game Management	Black Creek (V)	2-3	4,210	Conservation
2	Rattlesnake Game Management	Grove (T)	0-2	1,817	Conservation
3	Agricultural and Technical College	Alfred (V)	2	895	State University
		Broome County			
1	Chenango State Park	Chenango (T)	.5	983	Conservation
2	Whitney Point Reservation	Triangle (T)	———	4,200	Conservation
3	Binghamton State Hospital	Kirkwood (T)	.5	912	Mental Health
4	State University at Binghamton	Vestal (T)	2-3	522	State University
		Cattaraugus County			
1	Allegany State Park	Salamanca (C)	0-10	60,480	Conservation
2	Syracuse College of Forestry	Red House (T)	———	1,983	State University
		Cayuga County			
1	Howland Island Game Management	Port Byron (V)	———	3,200	Conservation
		Chautauqua County			
1	Canadaway Creek Game Management	Arkright (T)	———	2,035	Conservation
		Chemung County			
1	Elmira Reception Center and Farm	Elmira (C)	———	744	Correction
		Chenango County			
1	Pharsalia Game Management	Pharsalia (T)	———	4,420	Conservation
		Clinton County			
1	Macomb Reservation	Schuyler Falls (U)	2-4	700	Conservation
2	Lake Alice Game Management	Chazy (T)	4	1,465	Conservation
3	Ausable Game Management	Peru (T)	———	712	Conservation
4	Clinton Prison	Dannemora (T)	———	12,719	Correction
5	Dannemora State Hospital Farm	Saranac (T)	0-2	313	Correction
		Columbia County			
1	Rogers Island Game Management	Greenport (T)	.5	270	Conservation
2	Wassaic State School Farms	Valatie (U)	.5	295	Mental Health
		Cortland County			
1	Syracuse College of Forestry	Preble (T)	1.5	989	State University
		Delaware County			
1	Bear Springs Game Management	Colchester (T)	———	7,186	Conservation

---

[1] Data provided by New York State Bureau of Solid Wastes Engineering and Community Environmental Health. State-owned lands are listed for illustration only; their inclusion in this table must not be interpreted as any guarantee of their availability, even though they are not subject to the legislative constraints that would affect privately-owned lands.

[2] C = City, T = Town, V = Village, U = Unincorporated.

Table 19-5
(continued)

Site No.	Site	Location	Distance to R.R. miles	Total Area acres	Owner (State Agency)
		Dutchess County			
1	Green Haven State Prison	Beekman (T)	.5	2,174	Correction
2	Mattewan State Hospital	Fishkill (T)	0-1	834	Correction
3	Harlem Valley State Hospital	Dover (T)	.5	1,066	Mental Health
4	Hudson River State Hospital	Poughkeepsie (C)	0-1	1,214	Mental Health
5	Wassaic State School	Amenia (T)	0-1	1,300	Mental Health
6	Stonykill Farm	Fishkill (T)	1-1.5	754	State University
		Erie County			
1	Gowanda State Hospital	Collins (T)	1	1,204	Mental Health
2	Newark State School	E. Aurora (V)	1	672	Mental Health
3	College at Buffalo	Amherst (T)	———	686	State University
4	W. Seneca State School	W. Seneca (T)	———	668	Mental Health
		Essex County			
1	Ray Brook State Hospital	N. Elba (T)	0-.5	544	Health
		Fulton County			
1	Training School for Boys	Perth (T)	———	544	Social Service
		Genesee County			
1	Tonawanda Game Management	Alabama (T)	———	1,929	Conservation
		Greene County			
1	New York Vocational Institute	Coxsacki (T)	0-1	880	Correction
		Jefferson County			
1	Perch River Game Management	Orleans (T)	———	5,677	Conservation
2	Wetlands Lake View	Ellisburg (T)	———	1,808	Conservation
3	French Creek	Clayton (T)	———	583	Conservation
4	Little John Game Management	Worth (T)	———	1,889	Conservation
		Lewis County			
1	Tug Hill Game Management	Montague (T)	———	4,960	Conservation
		Livingston County			
1	Craig Colony	Groveland (T)	0-.5	2,069	Mental Health
2	Ten Wildlife Management	Springwater (T)	———	3,694	Conservation
		Madison County			
1	Tioughnidga Game Management	Nelson (T)	———	3,604	Conservation
		Monroe County			
1	Hamlin Beach State Park	Hamlin (T)	3	1,118	Conservation
2	State Agricultural and Industrial School	Rush (T)	———	1,545	Social Services
		Niagara County			
1	Tonawanda Game Management	Wolcottsville (U)	———	2,797	Conservation
		Oneida County			
1	Marcy State Hospital	Marcy (T)	0-.5	815	Mental Health
2	Rome State Hospital	Rome (C)	———	1,617	Mental Health
3	Utica State Hospital	Utica (C)	———	1,381	Mental Health

Table 19-5
(continued)

Site No.	Site	Location	Distance to R.R. miles	Total Area acres	Owner (State Agency)
		Onondaga County			
1	3 Rivers Game Management	Lysander (T)	2	3,438	Conservation
2	Syracuse State School	Camillus (T)	0-.5	573	Mental Health
3	Clark Reservation	DeWitt (T)	.5	228	Conservation
		Ontario County			
1	Spenser Game Management	Canadice (T)	--------	677	Conservation
2	Ten Wildlife Management	Naples (T)	--------	860	Conservation
		Orange County			
1	Middletown State Hospital	Middletown (C)	.5	717	.Mental Health
2	Warwick State School	Warwick (T)	.5	696	Social Services
3	Palisades State Park	Monroe (T)	--------	7,338	Conservation
		Orleans County			
1	Lakeside Beach State Park	Carlton (T)	3	650	Conservation
2	Oak Orchard Game Management	Barre (T)	--------	2,051	Conservation
3	Albion State Training School	Albion (V)	.5	210	Correction
		Oswego County			
1	Three Mile Bay Game Management	Constantia (T)	--------	1,803	Conservation
2	Little John Game Management	Redfield (T)	--------	6,709	Conservation
3	Selkirk Shores State Park	Pulaski (V)	2-3	987	Conservation
4	College at Oswego	Oswego (C)	1	610	State University
5	Happy Valley Game Management	Albion (T)	3	261	Conservation
		Otsego County			
1	Home Folks Memorial Hospital	Oneonta (C)	2	306	Health
		Rensselaer County			
1	Capital District Game Management	Berlin (T)	--------	3,997	Conservation
		Rockland County			
1	Harriman State Park	Haverstraw (V)	--------	45,844	Conservation
2	Tallman Mountain State Park	Nyack (V)	1-2	687	Conservation
3	Rockland State Hospital	Orangetown (T)	--------	691	Mental Health
4	Letchworth Village	Thiells (T)	0-2	1,971	Mental Health
		St. Lawrence County			
1	Wilson Hill Game Management	Louisville (T)	--------	3,410	Conservation
2	St. Lawrence State Hospital	Ogdensburg (C)	1.5	1,391	Mental Health
3	Agricultural and Technical College	Canton (V)	2	669	State University
4	Syracuse College of Forestry	Clifton (T)	--------	500	State University
5	Yellow Lake	Rossie (T)	--------	689	Conservation
		Saratoga County			
1	Vishers Ferry Game Management	Clifton Park (T)	--------	810	Conservation
2	Rome State School	Wilton (T)	--------	1,608	Mental Health
		Schuyler County			
1	Connecticut Hill Game Management	Catherine (T)	--------	673	Conservation
2	Sugar Recreation Area	Orange (T)	--------	2,000	Conservation
3	Cornell University	Cayuga (T)	--------	8,000	State University
		Seneca County			
1	Sampson State Park	Seneca Falls (U)	--------	1,000	Conservation
2	Willard State Hospital	Ovid (T)	1	1,963	Mental Health

Table 19-5
(continued)

Site No.	Site	Location	Distance to R.R. miles	Total Area acres	Owner (State Agency)
		Steuben County			
1	Erwin Game Management	Erwin (T)	—	2,504	Conservation
		Suffolk County			
1	Hither Hills State Park	E. Hampton (T)	0-1	1,755	Conservation
2	Islip State Hospital	Islip (T)	2	939	Mental Health
3	Pilgrim State Hospital	Babylon (T)	2	1,880	Mental Health
4	Kings Park State Hospital	Smithtown (T)	0-.5	891	Mental Health
5	Suffolk State School	Huntington (T)	—	685	Mental Health
6	State University at Stony Brook	Babylon (T)	—	1,168	State University
7	Agricultural and Technical Institute	Huntington (T)	2	795	State University
		Sullivan County			
1	Woodbourne Institute	Fallsburg (T)	—	847	Mental Health
2	Otisville State Training School	Mamakating (T)	—	1,215	Mental Health
		Tompkins County			
1	Buttermilk Falls State Park	Ithaca (C)	—	675	Conservation
2	Treman State Park	Ithaca (C)	—	1,020	Conservation
3	Taughannock Falls State Park	Ithaca (C)	—	742	Conservation
4	Cornell University	Ithaca (C)	—	507	State University
5	Connecticut Hill Game Management	Newfield (T)	—	3,090	Conservation
		Ulster County			
1	Wallkill Prison	Shawangunk (T)	0-.5	850	Correction
2	Eastern Correctional Institute	Wawarsing (T)	—	735	Correction
		Ulster County			
1	Wallkill Prison	Shawangunk (T)	0-.5	850	Correction
2	Eastern Correctional Institute	Wawarsing (T)	—	735	Correction
3	Ellenville Game Management	Ellenville (T)	—	8,000	Conservation
4	Highland State School	Lloyd (T)	—	372	Social Services
		Washington County			
1	Great Meadow Correctional Institute	Fort Ann (T)	.5	2,274	Correction
		Wayne County			
1	Port Bay Beaver Creek	Huron (T)	—	617	Conservation
2	Newark State School	Arcadia (T)	0-.5	517	Mental Health
		Westchester County			
1	Westfield State Farm	Bedford (T)	.5	834	Correction
		Wyoming County			
1	Silver Lake State Park	Silver Springs (V)	1	734	Conservation
2	Carlton Hill Game Management	Middlebury (T)	—	2,445	Conservation
3	Attica Prison	Attica (V)	.5	934	Correction
		Yates County			
1	Ten Wildlife Management	Italy (T)	—	2,857	Conservation
2	High Tor Game Management	Italy (T)	—	1,697	Conservation

Table 19-8

Projected State Land Requirements for Disposal of Future Solid Wastes[1]

Service Area	Total Acreage of Selected State-Owned Lands	Percentage of Selected State-Owned Lands Required to Dispose of Future Solid Wastes				
		1970-1975	1975-1985	1985-1995	1970-1985	1970 1995
Northern Region	40,300	1	2	3	3	6
Buffalo-Rochester Service Area	26,100	7	18	27	26	53
Central State Service Area	53,700	2	5	9	7	16
Hudson Valley Service Area	48,200	2	5	8	7	15
Southwestern Region	89,800	1	1	2	1	3
Lower Hudson Service Area	50,100	1	4	5	5	10
New York City Service Area	------------	----	----	----	----	------
Long Island Service Area	8,100	18	48	83	66	150
All Regions and Service Areas	316,300	4	9	14	13	27

[1] Consultant's Analysis.

Note: Use of the words "requirements" and "required" in connection with State-owned lands is for illustration of solid waste disposal requirements only, and must not be construed as any guarantee of the availability of State-owned lands.

CHAPTER TWENTY

ROLE OF THE STATE

Traditionally, solid waste disposal has been a local responsibility. If a municipality had problems, it could expect little assistance from outside sources. While an adjacent municipality may be sympathetic, no town wants to handle the wastes from another. Therefore, each municipality had to resort to its own method of providing solid waste disposal in the least objectionable manner. This usually resulted in a fragmented approach to disposal technology, because local municipalities generally could not afford to conduct research in methodology. Therefore, it is apparent that a level of government higher than the local municipality must be involved if solid wastes are to be disposed of properly and economically.

As previously discussed, New York State must establish overall objectives, define goals for obtaining the objectives, and develop a plan by which the objectives and goals may be implemented. However, the State government is comprised of many agencies and, thus, each agency should have its own goals and plans formulated to meet the State's objectives. Within the framework of each objective, there should be a consistent policy within which immediate and long-range decisions can be made, the goals should reflect these policies, and the policies will then determine the Role or scope of function that each agency is to assume.

Just as the data needs which have been discussed must be directed to specific local conditions, the Role or scope of functions of various governmental agencies in a given area cannot be predetermined. The determination of who will do what is vital to establish how the solutions will be implemented. An approach in one region may not be applicable to another. However, general considerations of governmental agency roles can be enumerated and discussed.

This chapter will consider two levels of involvement in solid waste management. The first will be the Role of the State. In this context the term "State" will refer to a level of government and not to specific governmental departments. The second level will be referred to as "Local" and is intended to refer to any involvement below the State level. Primarily, the term, local government, refers to towns, cities, and villages, but could also refer to counties, regions, or entire service areas.

ALTERNATIVE ROLES

The preceding discussions point out that State government has a role in solid waste planning and management; and that role must be clearly established. Following is a list of alternative roles broken down by varying levels of increasing State involvement:

State Level of Involvement	Description of Role	Scope of Actions
1. Control Agency	Review plans for technical sufficiency	Review local plans to insure that appropriate methods were used, that the functional operating elements are properly considered, and that the plans are realistic and can be implemented.
2. Control Agency	Review plans for scope and technical sufficiency.	Above scope, plus review plans to insure that all specific local conditions have been incorporated and that all foreseeable types of wastes are handled.
3. Control Agency	Review plans for scope, and for technical and geographical sufficiency.	Above scope, plus review plan with respect to geographical boundaries to insure that areas served are commensurate with the State objectives.
4. Control Agency and Technical Center.	All control agency functions, plus technical data center.	Above scope, plus provide data bank for dissemination of technical information and public relations materials. Provide technical advice and make the State computer system and programs available.

State Level of Involvement	Description of Role	Scope of Actions
5. Control Agency and Technical Center.	All control agency functions, plus technical service center.	Above scope, plus provide formal or in-field training programs and consultation. Use local data to develop local systems, using State programmers and computers. Sponsor research and development activities.
6. Above plus, Implementation Agency	All above functions, plus provide financial aid for implementation.	Above scope, plus administer construction grant funds or grant-in-aid programs for maintaining satisfactory operations.
7. Same as Above	All above functions, plus acquisition of Sites.	Above scope, plus provide a land bank through advance acquisition of sites or selection and reservation of State-owned lands, based on a Master Plan for the State.
8. Same as Above	All above functions, plus construction and/or operation of facilities.	Above scope, plus construction and/or operation of regional facilities. Special demonstration projects could be undertaken to demonstrate planning, engineering, or management techniques.

RECOMMENDED ROLE OF THE STATE

After careful analysis of the situation in New York State, it is the conclusion of ROY F. WESTON that the State level of involvement should be that of a control agency, a technical center, and in part an implementation agency.

This role will include all scopes of action through Level No. 6 (Financial Aid for implementation) and will also include planning for and promotion of advance site acquisition, and participation in construction and operation of special demonstration projects.

The State should sponsor local planning within the framework of the objectives, goals, and plans. Planning must be timely to insure that short-range and intermediate solutions are consistent with and moving toward the long-range plan.

The State should review solid waste plans for scope and technical sufficiency to insure that each plan is sufficient for the area considered, that it includes all types and sources of wastes, and that the design basis and implementation plan are complete and technically sound.

The State should review the geographical sufficiency of the plan. For example, it should check to see that all communities which should logically be considered together are in fact included in the plan, or that positive individual programs are underway for any excluded community.

The State should establish a technical data and service center to assist local agencies in all aspects of their solid waste programs. The mathematical model developed for the State master plan could be provided to the local agencies for development of local disposal systems. The State should also provide technical service to those communities that require assistance in upgrading their disposal systems and updating their current programs. For example, this may include services of a State solid waste consultant for a short period of time for specialized or unique problems or the training and licensing of operators. The State should also develop detailed guidelines for solid waste data collection efforts, to insure that the local efforts are complete in this regard before solutions are developed.

The State should consider a grant-in-aid program on a per capita basis to those communities maintaining satisfactory disposal operations. The major objective of such a program, which would certainly be compatible with the recommended State Role, would be to stimulate the communities or regions to achieve and maintain satisfactory levels of collection, handling, and disposal. Many communities still use inefficient collection and disposal practices, and significant economies could be achieved from elimination of these inefficiencies. To promote maximum accomplishment of the major objective and to avoid any use of the funds for perpetuation of inefficient practices, a set of guidelines for "satisfactory practice" must be developed. Thus, there would be two main thrusts in the program: 1) encouragement, by virtue of the funds to be made available; and 2) control, by careful definition of the qualifying conditions. An alternative or supplementary form of financial assistance could be State grants or loans for construction of facilities that meet the requirements of the State's Implementation Plan.

The State has also recognized that the availability of suitable land disposal areas will be a problem, because of public reaction and the increasing demand for land. Therefore, the recommended role includes site acquisition as an important State function. This effort requires a very detailed Implementation Plan so that the sites acquired are sure to fit into the plan in the future. However, this is not meant to imply that the State should provide land for disposal of all wastes in the State.

Solid waste disposal has been and will probably continue to be primarily a local responsibility. However, it is becoming increasingly evident that regionalization offers many advantages through the economy of scale of the larger operations and through a better capability of coping with the growing technical and land availability problems. The State has already shown, through the Pure Waters Authority and various Department of Health activities, the value of the expertise of a higher level of government in developing solutions for solid waste disposal problems. Demonstration projects involving the construction and/or operation of selected facilities, by the Pure Waters Authority or other State or State-sponsored agencies, would extend this influence. However, there are serious problems of intergovernmental relations and public attitudes that must be overcome. It is recognized that a conflict of interest may arise if the State assumes the functions of implementation and control, since these are not always compatible. Nevertheless, the State should complement the effort of and cooperate with municipalities and private enterprise in the design, construction, acquisition, and/or operation of disposal sites and facilities. While it should not be in the business of providing actual disposal of solid wastes, the State has a responsibility to develop and demonstrate solid waste planning, engineering, and management techniques and to set up the instruments for effective implementation.

CHAPTER TWENTY-ONE

PLAN AND PROGRAM

INTRODUCTION

Earlier in this report, a planning concept was outlined; the concept is dynamic in that it has the inherent ability to respond to change in conditions, yet it provides positive direction for meaningful action in light of the known or reasonably anticipated conditions. This concept is recommended for use in the continuing effort toward effective solid waste management in New York State. To be consistent with this recommendation and to initiate the effort, the Plan and Program developed from this study are presented in the form of Objectives, Goals, and Tasks.

It is necessary in any report to define terminology so that when a word is used, its meaning is properly conveyed. The term "plan" as used in the context of the preceding discussion implies action to be taken. However, the use of "plan" is widespread and often has different meanings. Therefore, it seems appropriate to refer to actions in the State program as "tasks", recognizing that "tasks" make up a "plan" as previously described.

BASIS FOR THE PLAN AND PROGRAM

Before the Objectives can be defined, the basic policy and direction must be established. The establishment of an Objective inconsistent with the policy or function of a State Government will generate effort which cannot and should not come to fruition. The basic policy required is the determination of the appropriate State Role and scope of function. This has been discussed, in Chapter Twenty, and a clear recommendation for this Role is available from analysis of all pertinent information.

The Goals and Tasks which are developed within the framework of the Objectives must reflect the conditions and needs existing in the State, as well as the priorities for fulfillment of those needs. These conditions and needs have also been reviewed in detail in various chapters of this report, and provide the basis for definition of appropriate Goals and Tasks.

THE DYNAMIC PLANNING CONCEPT - A REVIEW

Long-range planning is essential to the economic well-being of an individual, a corporation, or a Governmental body. Yet, the fixing of long-term effort based on today's knowledge may be quite short-sighted. The pace of technology is so rapid today that premature commitment to a particular solution may produce an obsolete system before it is completely implemented.

This apparent conflict can be resolved by a concept of dynamic planning, which can ensure progress while readily responding to change. The concept incorporates Objectives which provide the stable, long-term frame of reference for action. These are stated in a manner to be specific enough to provide positive direction, but yet sufficiently general that only basic policy changes can alter their permanency.

Goals are subordinate to Objectives and are the major guideposts along the direction indicated by an Objective. As a result, they must be stated as a more detailed or more positive planning element, and frequently contain a target date for accomplishment. Some planners identify Goals as representing achievement five years into the future. When a five-year plan is required (as is often the case for Governmental agencies), the Goals then may serve as the outline for a five-year planning effort.

Tasks are subordinate to Goals and must contain the details of the elements requiring attention during the specific planning period. The period usually chosen is one year. Each Task must be definitive in that the task or tasks required to complete it must be clearly outlined. Each must be measurable in terms of the progress toward completion at any desired status review point. This usually requires that a target date for completion be incorporated into each task. It is recognized that certain Goals require a continuing or regular effort for full achievement of the desired status. In such a case, a Task may never be completed, because it covers what is inherently a continuing effort. An example of such a Task is the periodic review of operating reports submitted to the State by local or regional facilities.

At the end of each year, the entire set of Objectives, Goals, and Tasks must be reviewed. Objectives are seldom altered except to change emphasis or to include a new element, because they reflect basic policy which, when properly established, seldom changes. Goals and Tasks are reviewed for progress or completion in light of any changes in conditions, needs, or priorities. Necessary changes are made to the Goals, and a complete set of Tasks is developed for the next planning year.

A complete set of Objectives, Goals, and Tasks has been developed for the New York State solid waste program and is presented on the following pages. It reflects the conclusions and recommendations derived from this study in the solid waste management program.

Since several agenices at the State government level have varying degrees of involvement with solid wastes, it is logical to assume that action would be required from each agency to attack a total program effectively. The specific actions are defined in the Objectives, Goals, and Tasks, but no effort has been made to differentiate between agencies or agency functions. Supplemental planning effort will be required to assign each Task to the appropriate agency, and perhaps to add Tasks or even Goals in areas not covered by this study.

The following set of Objectives, Goals, and Tasks has been jointly developed by NEW YORK STATE personnel and ROY F. WESTON. It represents the actions discussed in this report as well as programs currently underway by the Bureau of Solid Wastes Engineering and Community Environmental Health. Tasks and targets are set to cover both 1970 and 1971, and the time period over which the action will take place is shown in bar graph form.

Before presenting these Objectives, Goals, and Tasks in tabular form, the following discussion is offered to clarify the many actions and their relationships to the chapters and sections of this report which contain the detailed background for each action.

The first step in a planning effort is to establish and present the basic objectives. In this case, the Objectives are as follows:

I. Achieve and maintain effective disposal of all solid wastes in New York State.

   This Objective should cover all of the actions necessary for development of design and operating criteria and for proper enforcement of laws, rules, and regulations pertaining to solid wastes in the State.

II. Achieve efficient and economical disposal of all solid wastes in New York State.

   This Objective recognizes the responsibility of the State to aid the local and regional systems in obtaining economical solutions. It also covers the planning function at the State level.

III. Develop and maintain competent solid waste management practices.

Any solid waste system will be only as good as the quality of its operation, regardless of how well it has been designed. Enforcement must continue into the operating phase, and training programs can be most easily organized and conducted at the State level.

IV. Provide proper utilization and conservation of resources.

In the process of handling and disposing of solid wastes, the environment may be damaged, the wastes themselves may have some value, and land resources may be consumed or altered. A solid waste management program must consider each of these factors in addition to the actual practice of handling and disposal to obtain the maximum beneficial use from any selected site.

Within each of these four Objectives, several Goals are set, each contributing to the attainment of the Objective. These Goals and their relation to this report will be discussed in the following paragraphs.

Objective I. Achieve and maintain effective disposal of all solid wastes in New York State.

Five areas of activity are needed to achieve this Objective. The first relates to the enforcement action necessary to insure that all new facilities are constructed properly. Since existing controls are inadequate, the specific actions required are in developing guidelines for proper disposal and operation practices and in developing legislation to institute a permit system (See Chapter 9).

The second goal is complementary to the first and considers the incentives for effective systems such as construction and operation grants (See Chapter 20). All wastes should be effectively handled, regardless of whether they are of domestic or industrial origin. The third goal recognizes that very little information is available on wastes from the industrial segment, and its tasks are directed at efforts to obtain the data necessary for reasonable evaluation of these wastes (See Chapter 17).

The fourth Goal is directed at nuisance-free diposal. Earlier goals referred to effectiveness, but additional procedures are required to insure that odors, litter, vermin and other nuisances are controlled (See Chapter 17). Finally, any control program requires periodic inspection, and the last Goal is directed to such inspection efforts. Initial programs include additional training for the Solid Wastes Bureau staff as well as beginning the inspection programs (See Chapter 9).

Objective II. Achieve efficient and economical disposal of all solid wastes in New York State.

Five Goals have been chosen to direct efforts toward this Objective. To ensure that a coordinated program is devised for the entire State, a master implementation plan is proposed. The first Goal covers the development of the master plan through the completion of comprehensive regional planning studies and utilization of a computer model. The second Goal sets up the tasks to keep all planning efforts current by a continuing program of evaluation (See Chapter 20). The third Goal recognizes that existing facilities must be considered and factored into the master plan wherever possible. Tasks are outlined to obtain necessary facility data for evaluation (See Chapter 17).

Several agencies of the State of New York have interest and responsibility in planning, implementation and operation of solid wastes systems. This report confines itself to the Role of the composite of these agencies, but the fourth Goal under this Objective recognizes that specific tasks must be set for each agency in accordance with their assigned responsibilities. (See Chapter 20).

New York State does not have many functioning examples of regional efforts to solve environmental problems. The costs of solid waste disposal plus the increasing complexity of the problem strongly indicates a need for regional solutions. The tasks under the fifth Goal initiate efforts toward achieving acceptance of the regional approach. (See Chapters 9 and 20).

Objective III. Develop and maintain competent solid waste management practices.

Two areas of activity have been identified for this Objective. The first goal includes guidelines for data collection, recording, and accounting procedures, plus development of technical aids for the local governments (See Chapters 17 and 20). The second goal outlines the efforts necessary to institute an operator training and certification program (See Chapter 20).

Objective IV. Provide proper utilization and conservation of resources.

Three separate and distinct programs are required for this Objective, and each constitutes a Goal. The first goal considers that salvage and quantity reduction of wastes must be viewed on a source-by-source basis, but the State can provide research and development of applicable techniques. (See Chapter 20). The second goal recognizes that protection of the environment is always a concern with any disposal operation, and that in the case of sanitary landfill environmental enhancement may occur through land redevelopment (See Chapter 18). The third goal reemphasizes that land is a natural resource, and that operations which use the land must be viewed carefully to ensure that this fixed resource is used properly (See Chapter 18).

The subsequent pages show the Objectives, Goals, and Tasks in tabular form, along with the schedule and target dates for each action. As stated earlier, this plan and program must be dynamic. It must be reviewed frequently and modified if conditions or policies change. Most important, however, is the immediate problem of insuring cooperation and coordinated action among local governments and all of the specific agencies and departments of the State of New York.

OBJECTIVE I - ACHIEVE AND MAINTAIN EFFECTIVE DISPOSAL OF ALL SOLID WASTES IN NEW YORK STATE.

Goal A - Require that equipment and facilities are constructed and operated properly.

Task 1. Prepare proposals for legislation authorizing a permit system, and submit to State Legislature.

Task 2. Develop administrative procedures for the permit system, including preparation of Environmental Health Manual items, permit and application forms, conditions of approval, etc.

Task 3. Prepare and enact regulations for the permit system under new legislation, and revise any applicable existing regulations.

Task 4. Develop standards for design, construction, and operation of collection, transportation, processing, and disposal facilities.

Task 5. Initiate and administer the permit system.

Goal B - Provide Legislation, Regulations, and Other Means of Attaining Quality Construction and Operation.

Task 1. Prepare proposals for legislation authorizing grants-in-aid to municipalities for preparation of detailed plans for construction of disposal facilities. Submit proposal to State Legislature.

Task 2. Develop administrative procedures for a grant-in-aid program for detailed planning, including preparation of Environmental Health Manual items and application forms.

Task 3. Prepare and enact regulations for the grant-in-aid program for detailed planning.

Task 4. Initiate and administer the grant-in-aid program for detailed planning.

Task 5. Prepare proposals for legislation authorizing a per capita grant-in-aid program to promote construction, operation, and maintenance of systems complying with State requirements. Submit proposal to State Legislature.

Task 6. Develop administrative procedures for the per capita grants-in-aid program, including preparation of Environmental Health Manual items, application, and qualification forms.

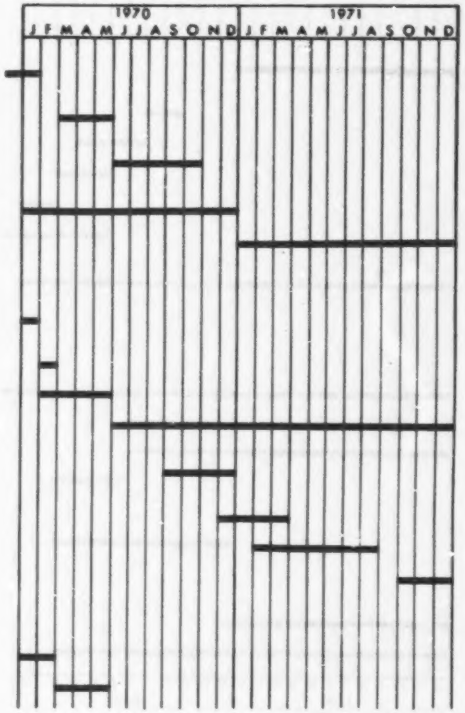
Task 7. Prepare and enact regulations for the per capita grant-in-aid program, defining qualifications for eligibility.

Task 8. Initiate and administer the per capita grant-in-aid program.

Goal C - Ensure That Management Systems are Capable of Handling All Waste in the Area Served.

Task 1. Advise the U. S. Public Health Service of the intent of New York State to redesign the present waste inventory system in accordance with a functional waste classification system, and request their support of this procedure.

Task 2. Develop a demonstration project on data collection using the waste classification system.



Task 3. Develop new questionnaires and instructions for municipal, agricultural, and industrial waste data collection and begin data collection efforts.

Task 4. Evaluate results of surveys and make recommendations for necessary improvements.

Goal D - Require Nuisance-Free Operation of Solid Waste Management Systems.

Task 1. Develop and make available model local ordinances and contracts for storage, collection, transportation, processing, and disposal of solid wastes.

Goal E - Provide Effective Administration and Enforcement of Applicable Laws, Rules and Regulations.

Task 1. Prepare training program for facility inspection and evaluation by professional staff.

Task 2. Conduct facility inspection and evaluation training program.

Task 3. Prepare inspection manuals and operation manuals.

Task 4. Establish compliance schedules for sub-standard operations.

OBJECTIVE II - ACHIEVE EFFICIENT AND ECONOMICAL DISPOSAL OF ALL SOLID WASTES IN NEW YORK STATE.

Goal A - Develop a Master Implementation Plan for the State to Determine the Most Effective Systems in the State.

Task 1. Complete comprehensive county or regional solid waste planning studies for all counties in the State.

Task 2. Develop a mathematical model using functional waste classifications for solid waste management system analysis and design.

Task 3. Select a county or region to serve as a model test run area.

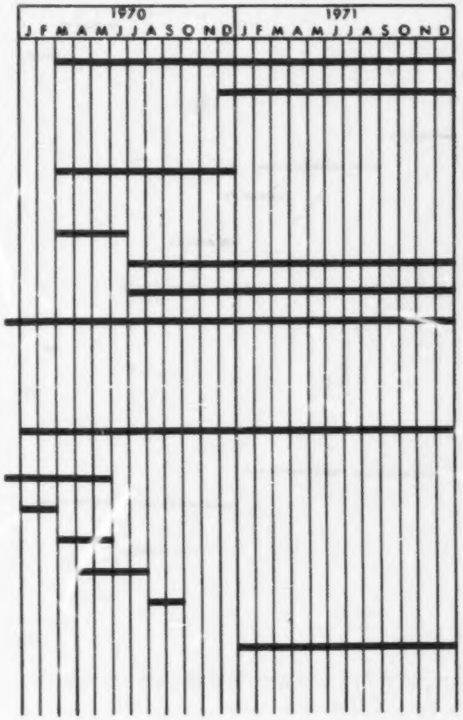
Task 4. Collect supplemental data needed for the test area.

Task 5. Develop data input and make initial model run.

Task 6. Field check the model results and refine the model as necessary.

Task 7. Use the model to update and correlate comprehensive county and regional studies to develop a State-wide master implementation plan.

Goal B - Keep the Master Implementation Plan Current by Periodic Review, and Coordinate Local or Regional Implementation Plans With the Master Plan.



Task 1. Develop personnel capability to apply and use the mathematical model.

Task 2. Develop guidelines for uniform data collection procedures for use in updating local, regional, or master implementation plans.

Task 3. Update guidelines for solid waste management planning.

Task 4. Maintain surveillance over existing solid waste management practices to determine changes made and compatibility with master implementation plan.

Task 5. Using a mathematical model, determine the most efficient intergovernmental combination for phased revision of master implementation plan.

Goal C - Make Maximum Use of Existing Facilities Where Feasible.

Task 1. Develop a new questionnaire for sanitary landfill evaluation, and reappraise existing facilities to determine necessary improvements.

Task 2. Develop evaluation guidelines, and conduct a survey of transfer stations and incinerators or other processing facilities.

Task 3. Select an incinerator, transfer station, or other facility to demonstrate that applicable modification would increase the effectiveness and efficiency.

Task 4. Make recommendations for effective and efficient use of existing facilities.

Goal D - Coordinate Solid Waste Management Responsibilities of State Agencies.

Task 1. Assemble information on responsibilities and agreements between State agencies regarding solid waste management.

Task 2. Develop guidelines to be used by State agencies in establishing policies for solid waste management.

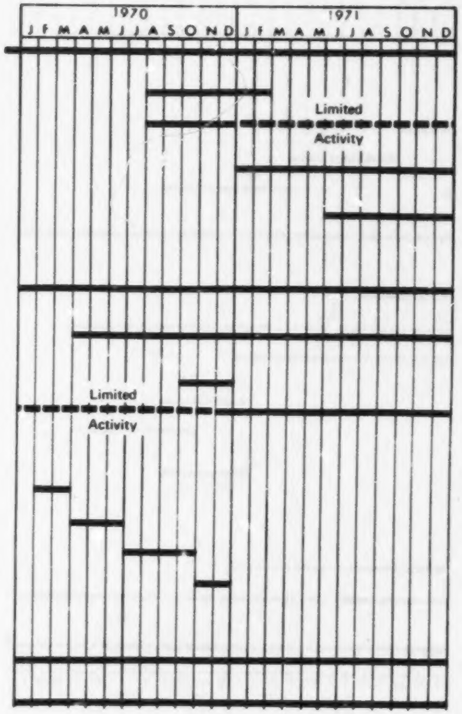
Task 3. Develop a statement of policy and goals regarding solid waste management for each State agency.

Task 4. Review State objectives and goals and prepare 1971 tasks

Goal E - Promote Regional Solid Waste Management.

Task 1. Select a subject, prepare a news release, and strive for maximum coverage of one article each month on successful solid waste disposal projects.

Task 2. Develop and publish informational brochures on inter-governmental solid waste management, and distribute to municipal officials.



Task 3. Publicize successful cooperation in intermunicipal solid waste management at least four times during the year.

Task 4. Seek invitations to present the land development concept of solid waste disposal using drawings prepared as a part of the 1969 study.

Task 5. Publicize the mathematical model concept and specific cases where the model has been applied.

OBJECTIVE III - DEVELOP AND MAINTAIN COMPETENT SOLID WASTE MANAGEMENT PRACTICES.

Goal A - Provide Management Assistance to Local Government.

Task 1. Prepare intermunicipal cost-sharing guidelines for financing of construction and operations.

Task 2. Prepare guidelines for uniform data reporting and record keeping in accordance with a functional waste classification system.

Task 3. Develop uniform municipal accounting procedures for solid waste collection and disposal.

Task 4. Run a mathematical model to assist local or regional agencies in improving existing operations and in developing implementation schedules for obtaining regional solid waste management systems.

Task 5. Review State and local manpower needs, and prepare recommendations for State and local action.

Task 6. Develop and staff a scientific data clearing house and library.

Goal B - Obtain Competent Operation of Solid Waste Management Systems.

Task 1. Develop and initiate an operator training program.

Task 2. Develop administrative procedures for an operator certification program, including preparation of Environmental Health Manual items, application forms, etc.

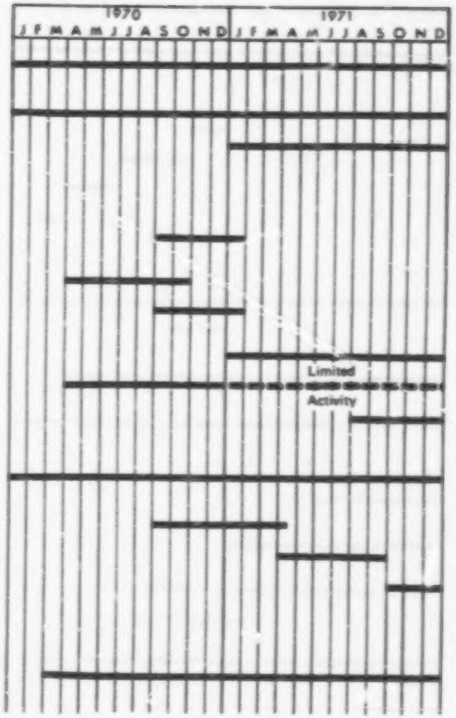
Task 3. Prepare and enact regulations for certification of operators.

Task 4. Initiate and administer operator certification program.

OBJECTIVE IV - PROVIDE PROPER UTILIZATION AND CONSERVATION OF RESOURCES

Goal A - Reduce Amount of Refuse Requiring Disposal.

Task 1. Develop at-source waste reduction techniques on a State-wide level.



Task 2. Develop programs to test and promote reduction, salvage, and recycling of solid wastes.

Task 3. Develop pilot projects to demonstrate the feasibility of waste reduction, salvage, and recycling.

Goal B - Utilize Solid Waste for Environmental Improvement.

Task 1. Review solid waste management elements of land use planning and incorporate with land development policy in New York State.

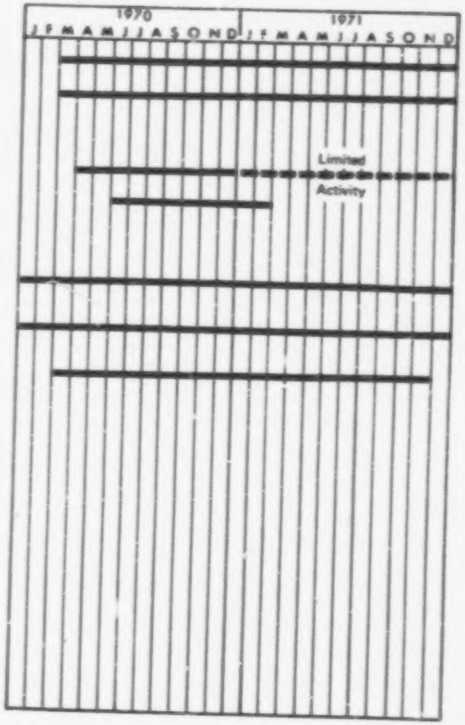
Task 2. Develop guidelines for disposal of segregated and specific wastes in marginal lands.

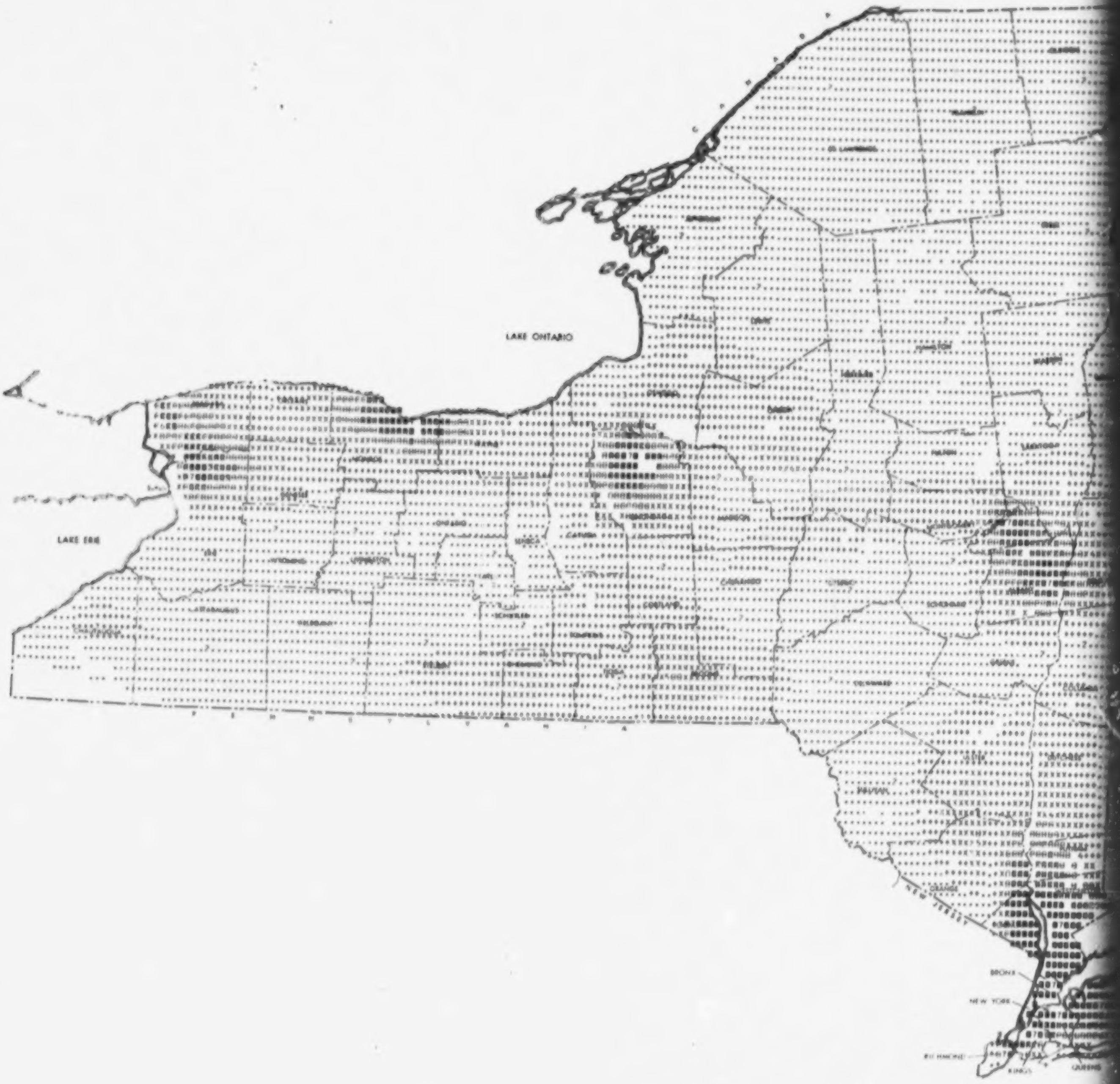
Goal C - Conserve and Improve Natural Resources.

Task 1. Promote efficient use of land devoted to solid waste disposal, and encourage planning for reuse of disposal sites.

Task 2 Encourage conservation of fixed land resources in New York State through proper planning and operation of waste management facilities.

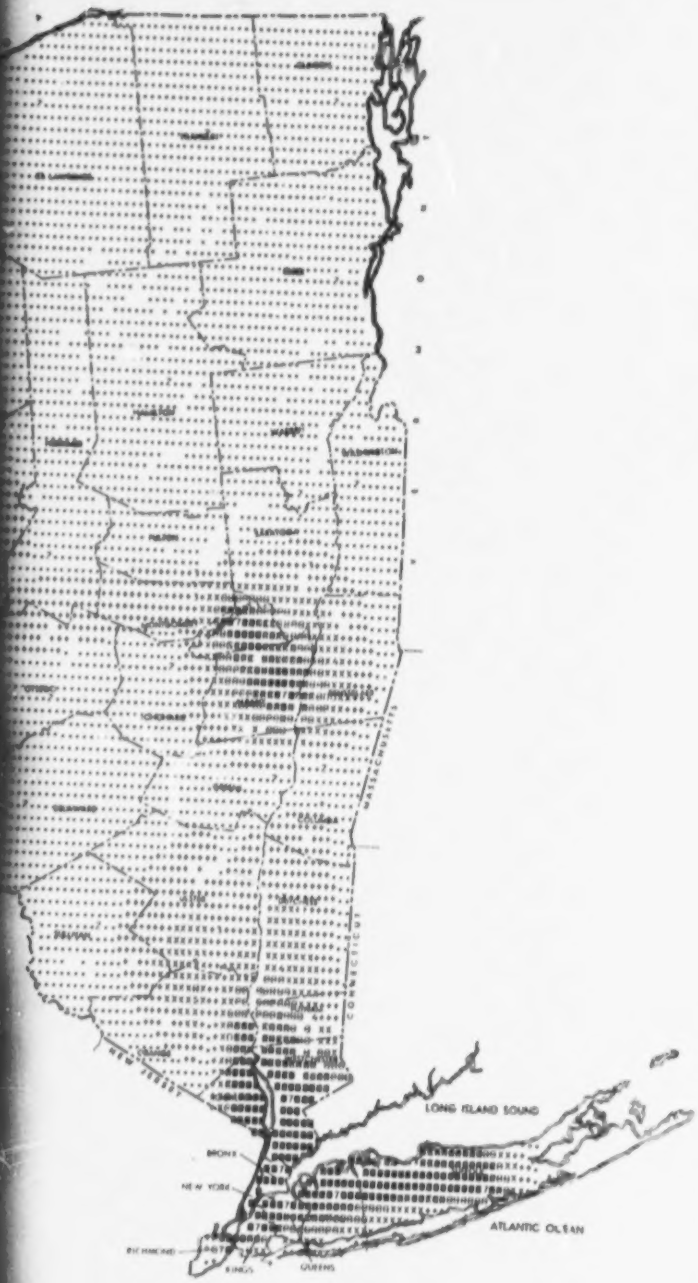
Task 3. Initiate research and demonstration projects exploring solid waste management techniques that minimize the consumption of or even enhance natural resources.




LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

Map 1

A


LONG ISLAND SOUND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
ATLANTIC OCEAN
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 1

NEW YORK STATE DEPARTMENT OF HEALTH

POPULATION DENSITY 1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	PERS./SQ. MI.
1	·	67	0.0 — 0.1
2	░	34	0.1 — 100.0
3	░	15	100.1 — 200.0
4	▒	7	200.1 — 300.0
5	▒	2	300.1 — 400.0
6	▓	1	400.1 — 500.0
7	■	14	500.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

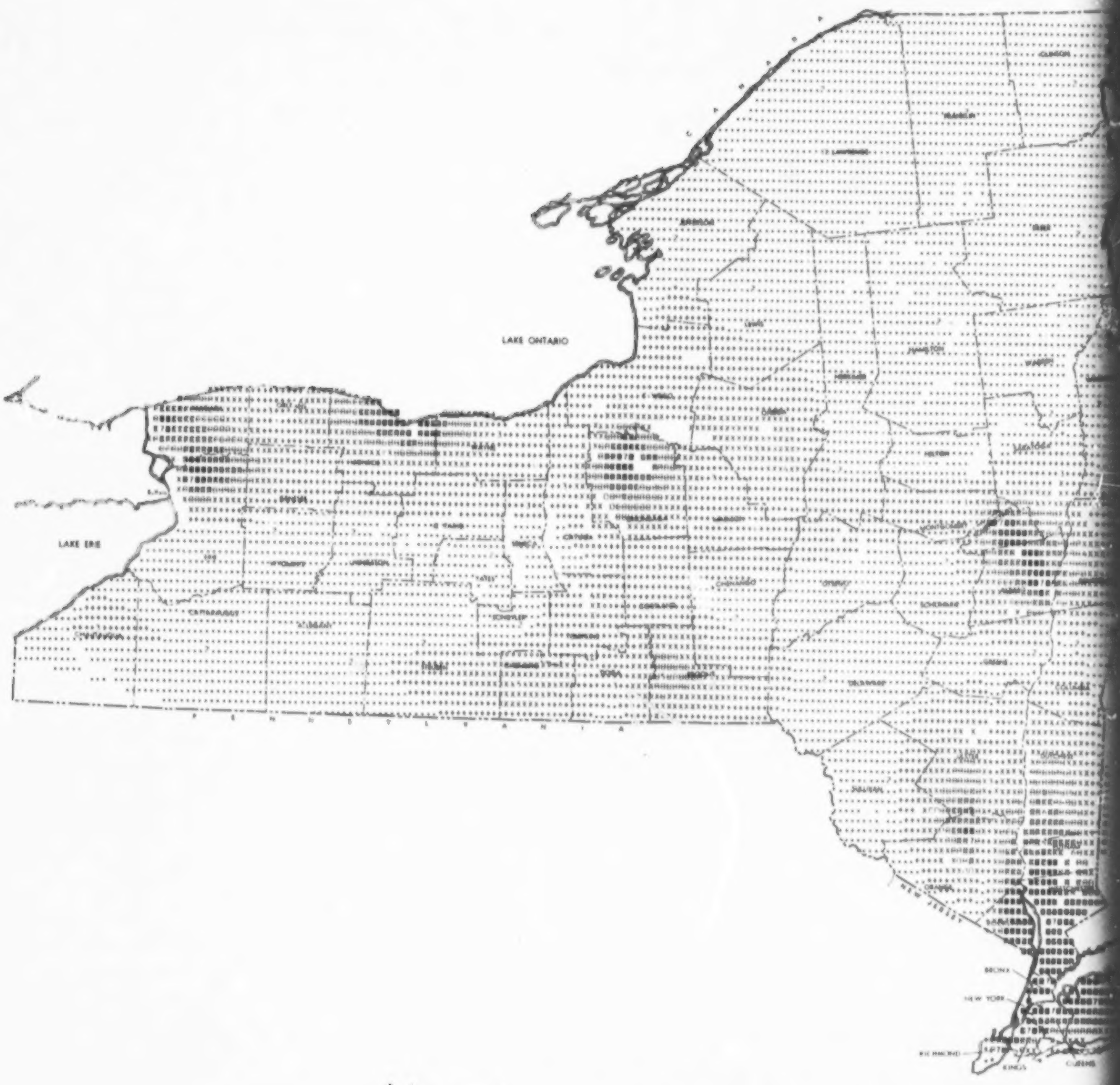
N

SCALE IN MILES

10 0 10 20 30 40 50 60 70

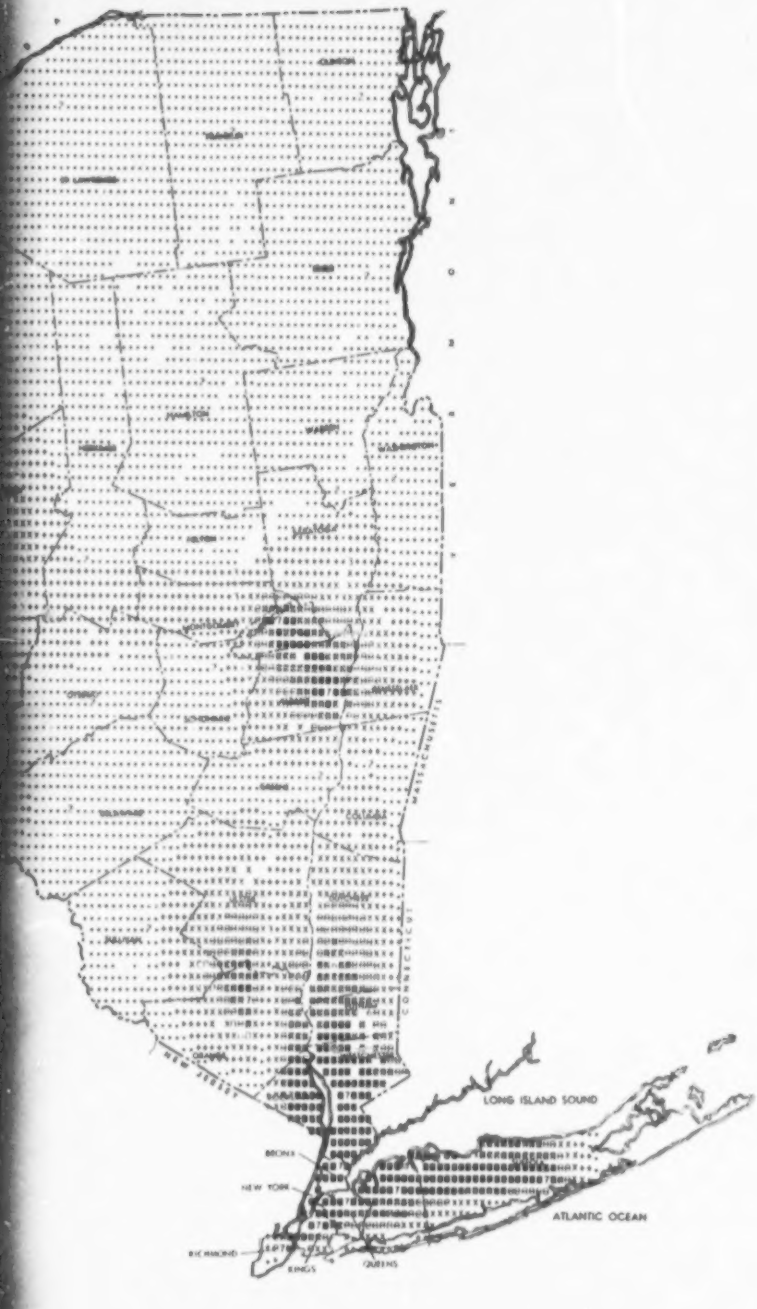
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
HAMILTON
PENNSYLVANIA
NEW JERSEY
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

Map 2

A


CLINTON
HAMILTON
WARREN
WASHINGTON
SULLIVAN
ORANGE
NEW JERSEY
MASSACHUSETTS
CONNECTICUT
LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 2

NEW YORK STATE DEPARTMENT OF HEALTH

POPULATION DENSITY

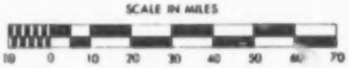
1985

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

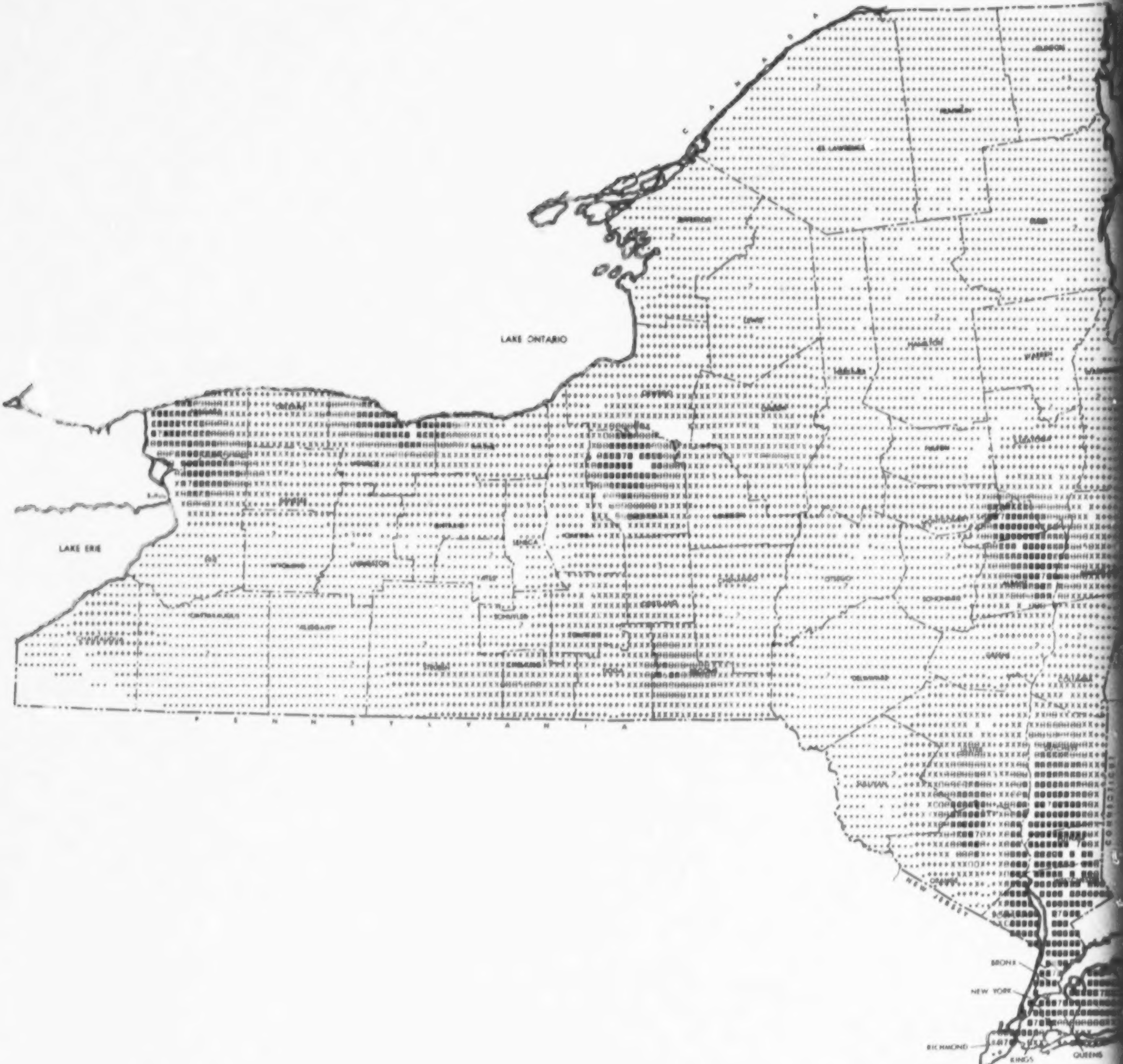
LEVEL	SYMBOL	FREQUENCY	PERS./SQ. MI.
1	·	67	0.0 — 0.1
2	⋯	28	0.1 — 100.0
3	⁞	18	100.1 — 200.0
4	×	6	200.1 — 300.0
5	▤	3	300.1 — 400.0
6	▦	2	400.1 — 500.0
7	■	16	500.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969


SCALE IN MILES
10
0
10
20
30
40
50
60
70

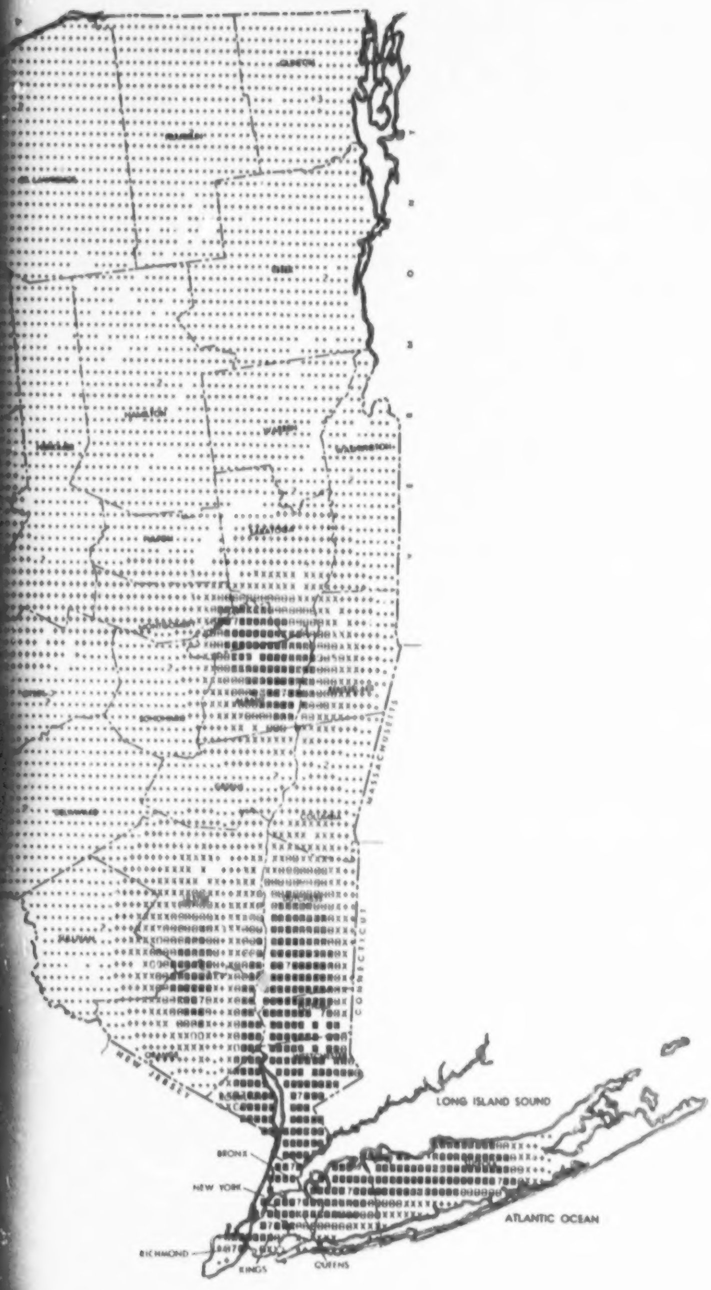
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
SENECA
PENNSYLVANIA
NEW JERSEY
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

Map 3

A


CLINTON
WASHINGTON
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
ATLANTIC OCEAN

MAP 3

NEW YORK STATE DEPARTMENT OF HEALTH

POPULATION DENSITY
1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	PERS./SQ. MI.
1	'	67	0.0 — 0.1
2	⋯	26	0.1 — 100.0
3	░	18	100.1 — 200.0
4	▒	5	200.1 — 300.0
5	▤	5	300.1 — 400.0
6	▓	1	400.1 — 500.0
7	█	18	500.1 AND OVER

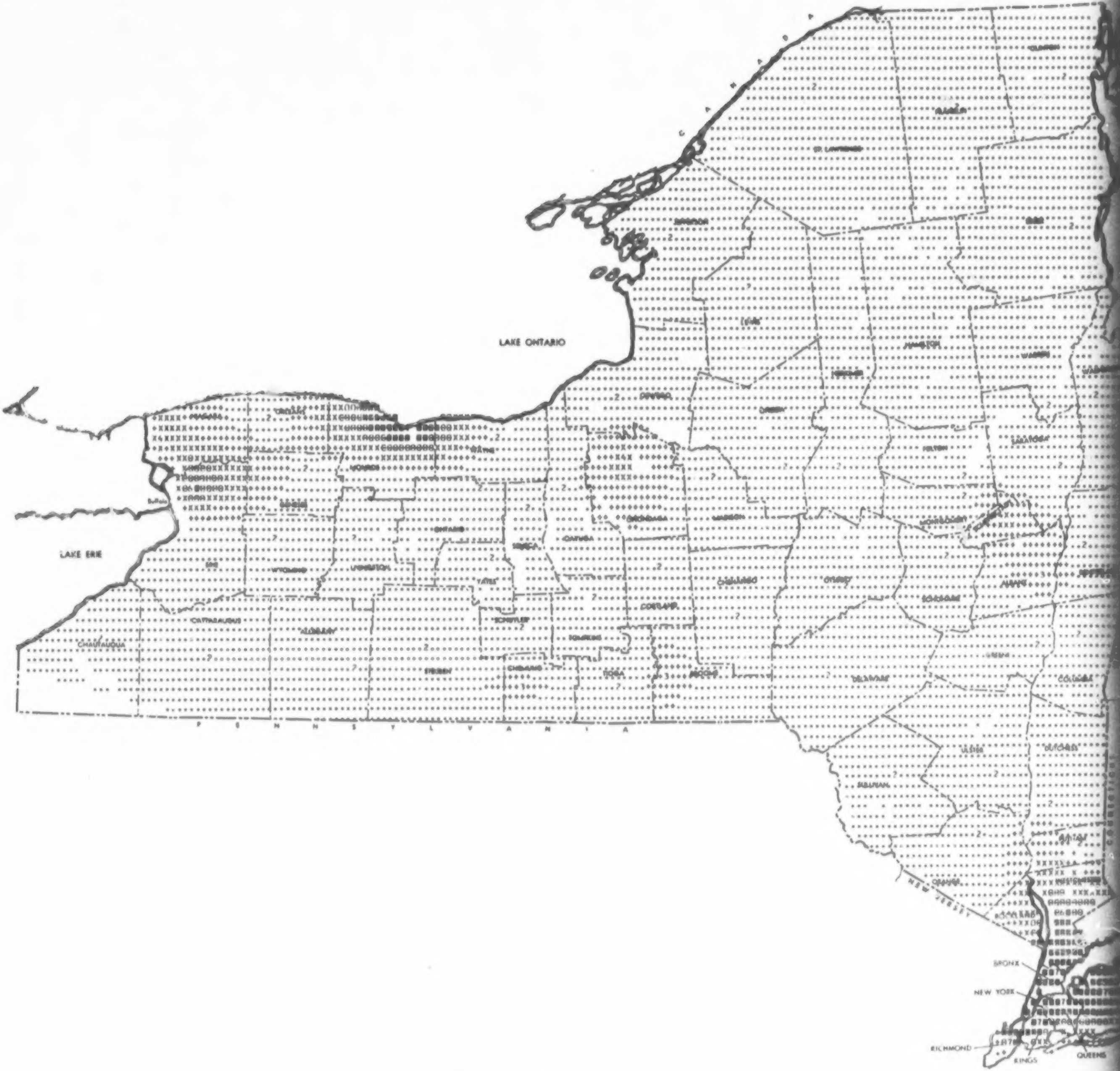
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

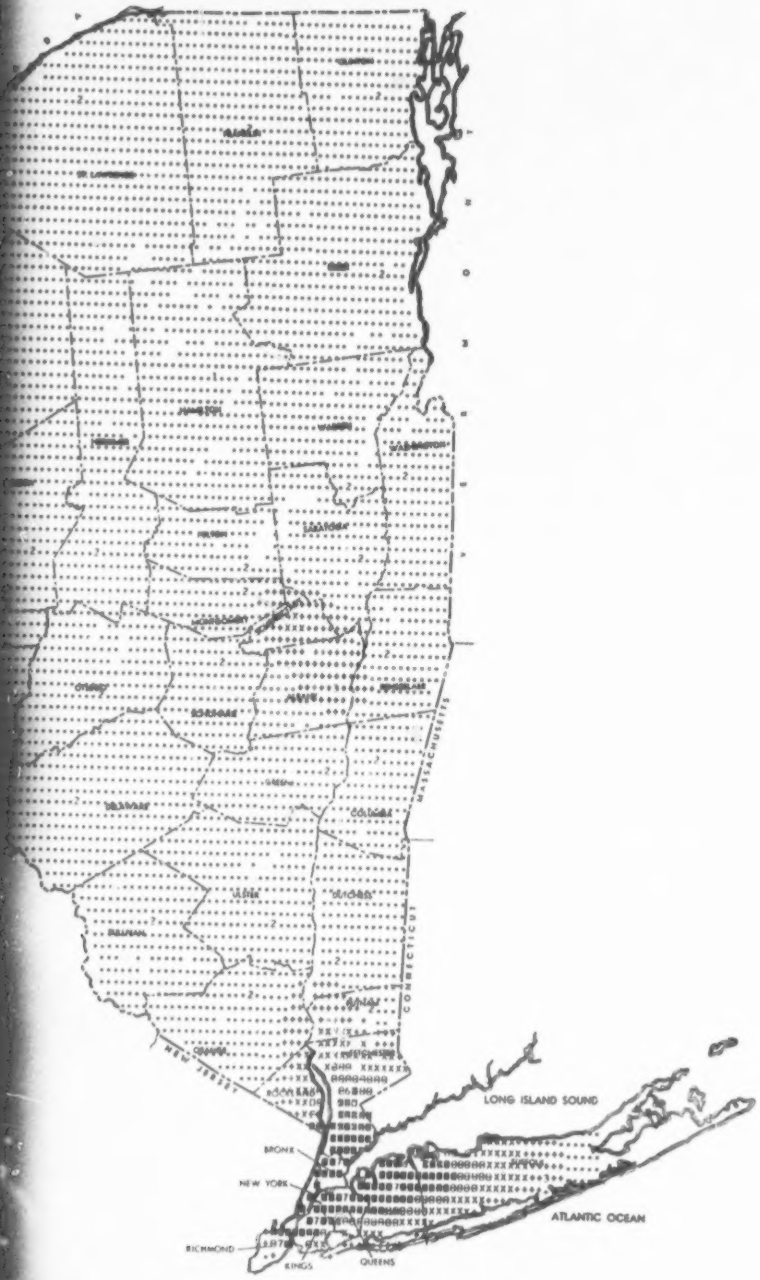
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
CLINTON
FRANKLIN
ST LAWRENCE
JEFFERSON
ESSEX
LEWIS
HAMILTON
WARREN
OSWEGO
ONEIDA
HERKIMER
FULTON
SARATOGA
ORLEANS
NIAGARA
MONROE
WAYNE
GENESEE
ERIE
WYOMING
LIVINGSTON
ONTARIO
SENECA
CAYUGA
ONONDAGA
MADISON
SCHENECTADY
YATES
CORTLAND
CHENANGO
OTSEGO
SCHOHARIE
ALBANY
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
SCHUYLER
TOMPKINS
CHEMUNG
TIOGA
BROOME
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

Map 4

A


CONNECTICUT
MASSACHUSETTS
NEW JERSEY
LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 4

NEW YORK STATE DEPARTMENT OF HEALTH

INDUSTRIAL EMPLOYMENT DENSITY 1970

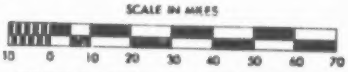
STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	PERS./SQ. MI.
1	'	68	0.0 — 0.1
2	·····2···	55	0.1 — 32.0
3	•••••••••	4	32.1 — 64.0
4	xxxxxxxxx	4	64.1 — 96.0
5	≈≈≈≈≈≈≈≈≈	0	96.1 — 128.0
6	▪▪▪▪▪▪▪▪▪	2	128.1 — 160.0
7	■■■■■■■■■	7	160.1 AND OVER

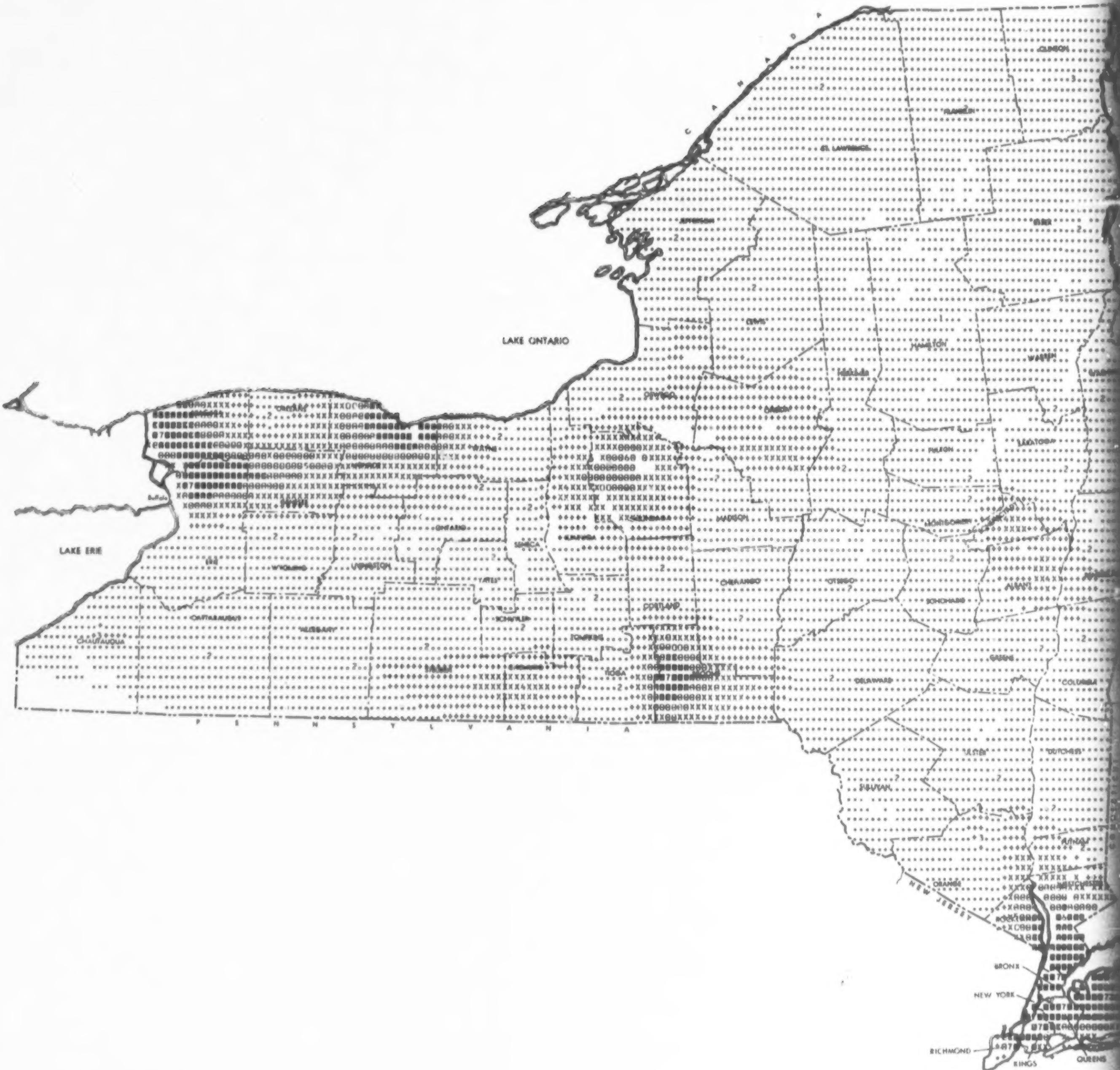
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N


SCALE IN MILES
10
0
10
20
30
40
50
60
70

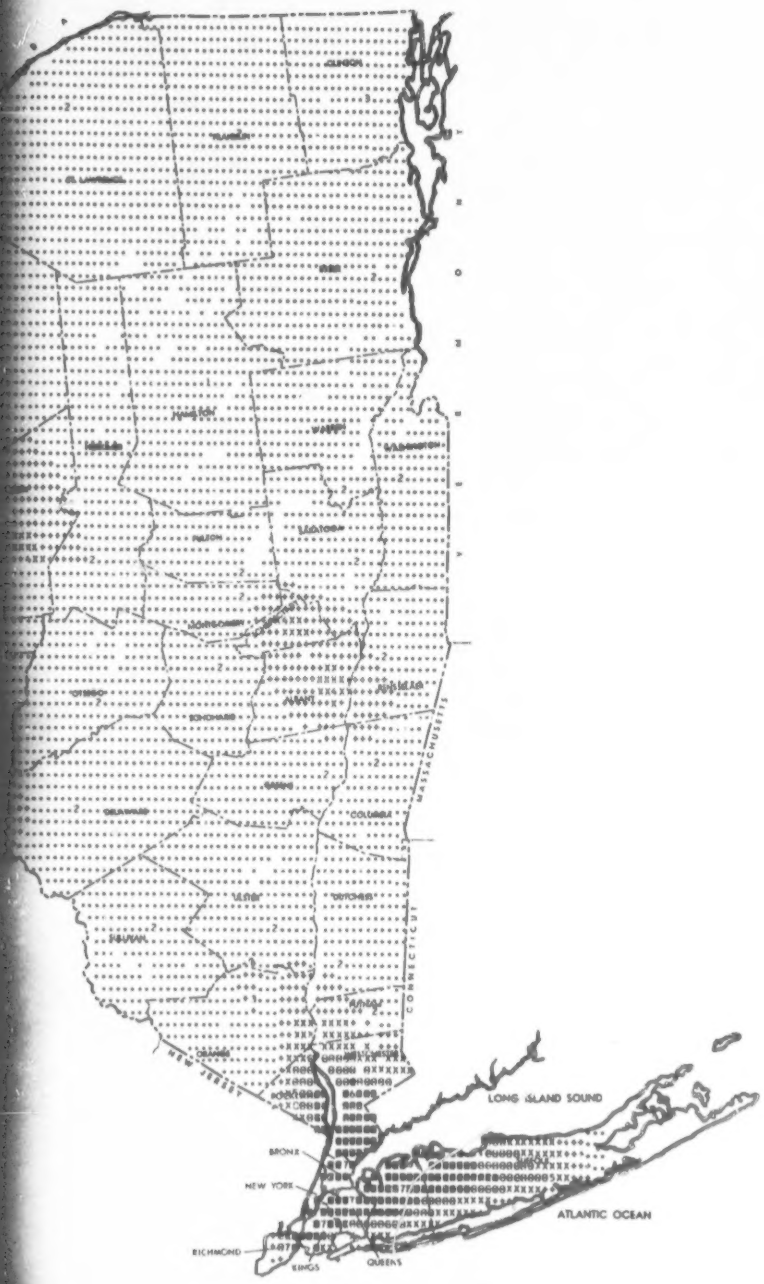
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
Buffalo
PENNSYLVANIA
NEW JERSEY
CLINTON
FRANKLIN
ST. LAWRENCE
JEFFERSON
ESSEX
LEWIS
HAMILTON
WARREN
HERKIMER
OSWEGO
ONEIDA
ORLEANS
WAYNE
SARATOGA
FULTON
MADISON
MONTGOMERY
ONTARIO
SENECA
ERIE
WYOMING
LIVINGSTON
YATES
CHENANGO
OTSEGO
ALBANY
SCHOHARIE
CATTARAUGUS
ALLEGANY
SCHUYLER
CORTLAND
TOMPKINS
CHAUTAUQUA
GREENE
TIOGA
BROOME
DELAWARE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
PUTNAM
ORANGE
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

Map 5

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
WARREN
WASHINGTON
FULTON
SARATOGA
MONTGOMERY
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
GREENE
DELAWARE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 5

NEW YORK STATE DEPARTMENT OF HEALTH

INDUSTRIAL EMPLOYMENT DENSITY 1985

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

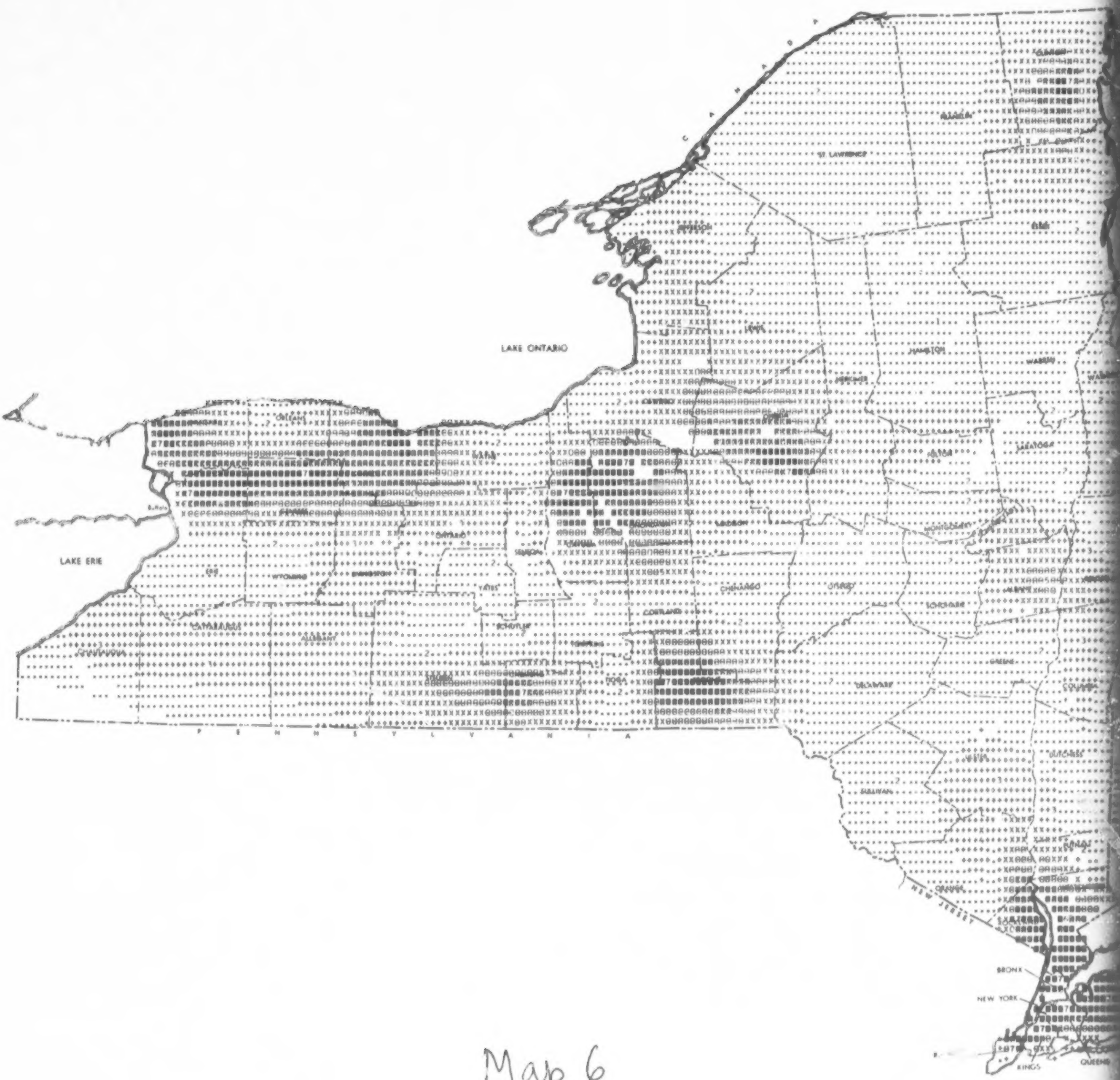
LEVEL	SYMBOL	FREQUENCY	PERS./SQ. MI.
1	ı	68	0.0 — 0.1
2	⁚⁚⁚	45	0.1 — 32.0
3	⁙⁙⁙	5	32.1 — 64.0
4	xxx	5	64.1 — 96.0
5	+++	5	96.1 — 128.0
6	▦	2	128.1 — 160.0
7	■	10	160.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N
SCALE IN MILES
10
0
10
20
30
40
50
60
70

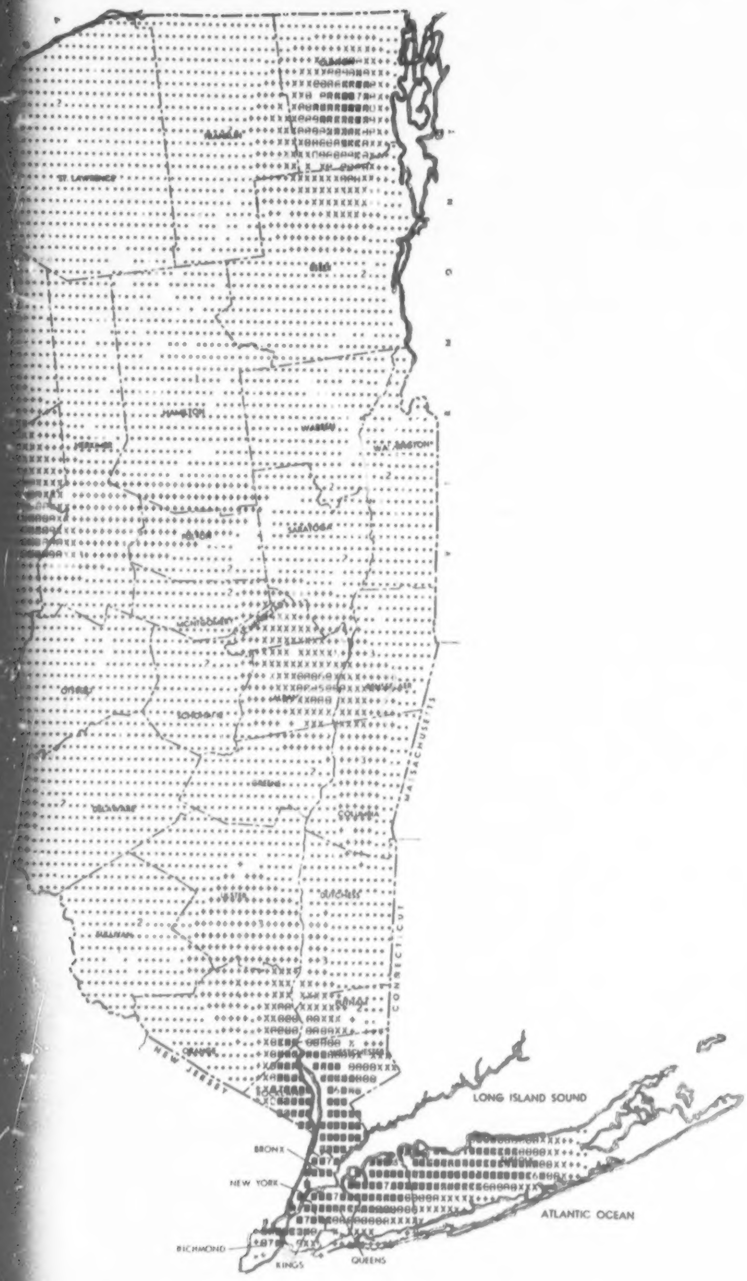
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

13


CANADA
ST LAWRENCE
JEFFERSON
LEWIS
HAMILTON
HERKIMER
LAKE ONTARIO
ORLEANS
OSWEGO
FULTON
SARATOGA
WARREN
LAKE ERIE
ERIE
WYOMING
LIVINGSTON
ONTARIO
SENECA
YATES
MADISON
CHENANGO
OTSEGO
SCHOHARIE
CORTLAND
SCHUYLER
CATTARAUGUS
CHAUTAUQUA
ALLEGANY
STEUBEN
CHEMUNG
TIOGA
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PENNSYLVANIA
NEW JERSEY
BRONX
NEW YORK
KINGS
QUEENS

Map 6

A


ST. LAWRENCE
HAMILTON
WARREN
WASHINGTON
SARATOGA
OTSEGO
SCHOHARIE
GREENE
COLUMBIA
DELAWARE
ULSTER
DUTCHESS
SULLIVAN
ORANGE
NEW JERSEY
MASSACHUSETTS
CONNECTICUT
LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 6

NEW YORK STATE DEPARTMENT OF HEALTH

INDUSTRIAL EMPLOYMENT DENSITY 1995

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	PERS./SQ. MI.
1	'	67	0.0 — 0.1
2	·	31	0.1 — 32.0
3	•	13	32.1 — 64.0
4	x	4	64.1 — 96.0
5	⊶	2	96.1 — 128.0
6	▨	4	128.1 — 160.0
7	■	19	160.1 AND OVER

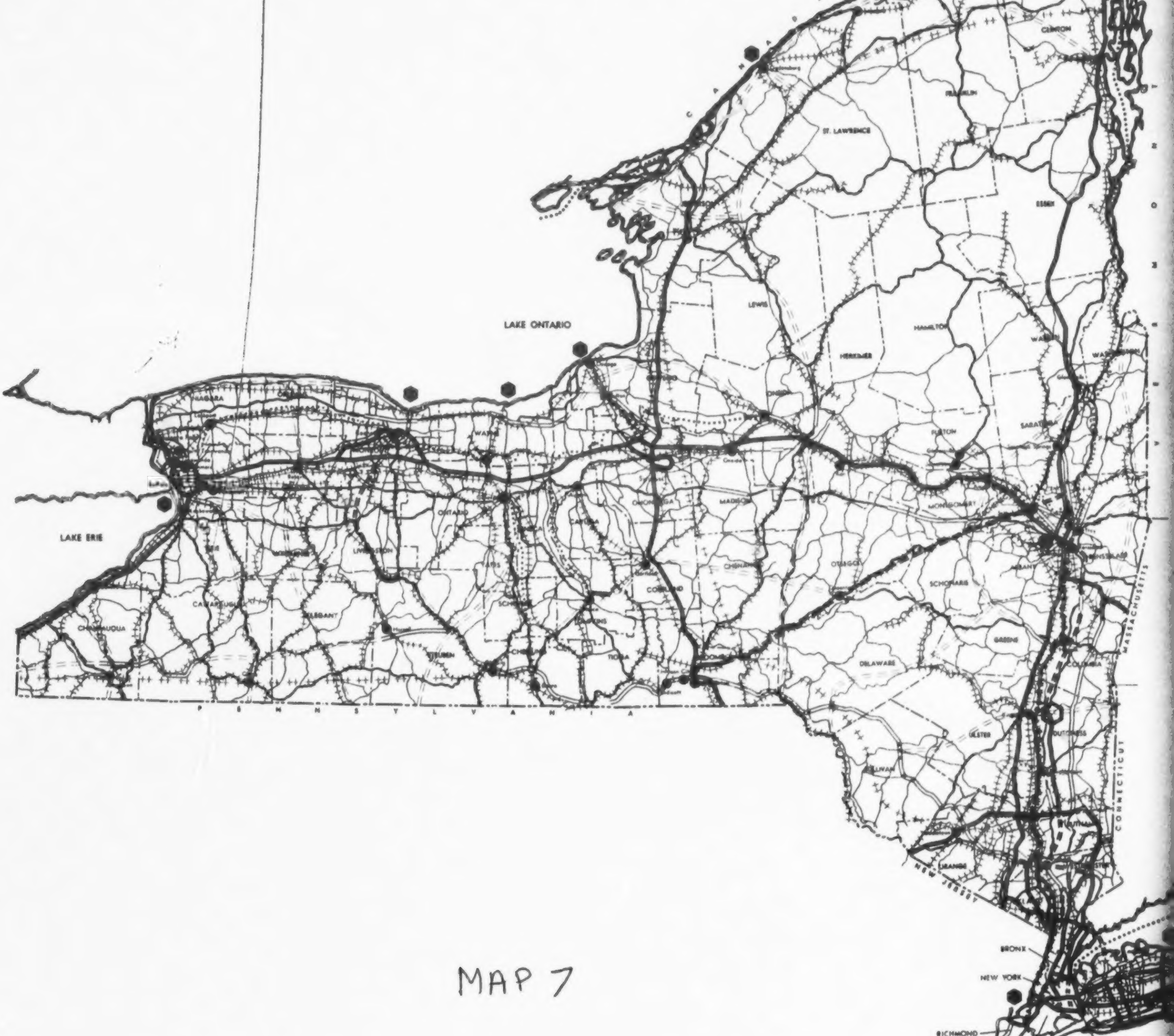
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

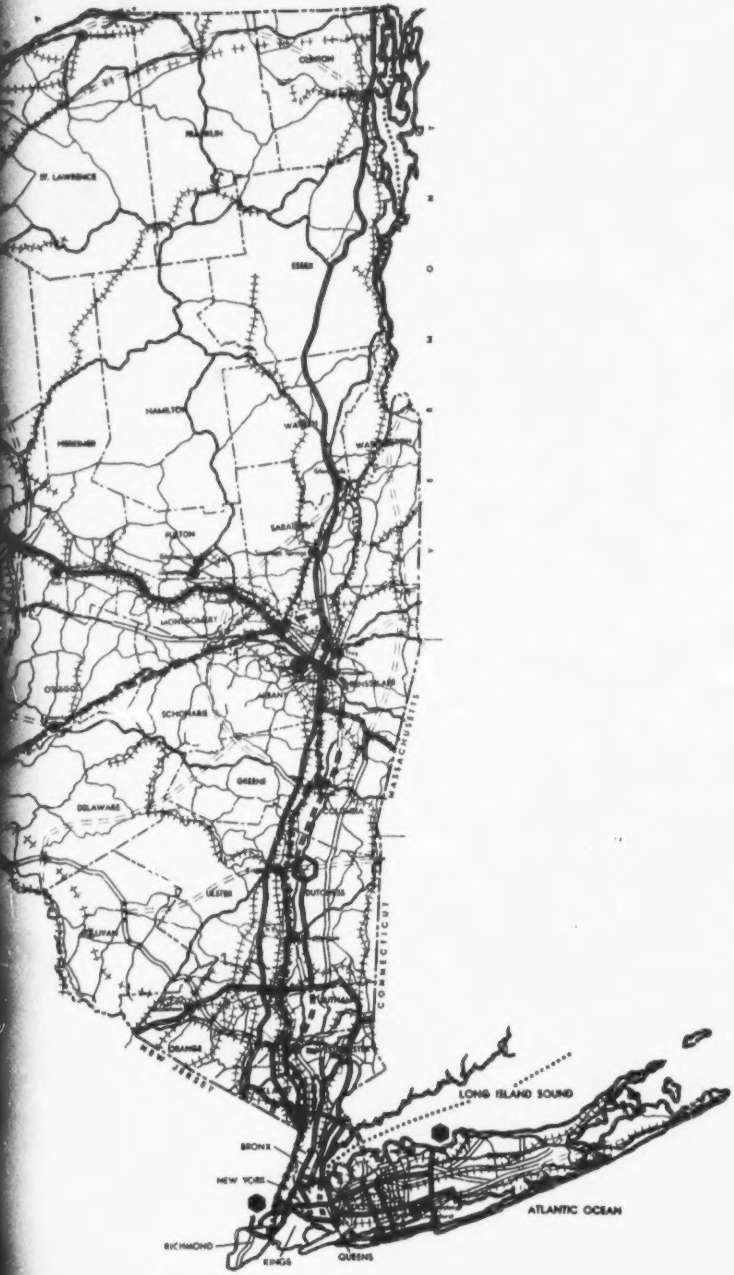
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
P E N N S Y L V A N I A
ST. LAWRENCE
FRANKLIN
CLINTON
ESSEX
LEWIS
HERKIMER
HAMILTON
FULTON
MONTGOMERY
MADISON
OTSEGO
SCHOHARIE
DELAWARE
GREENE
ULSTER
DUTCHESS
SULLIVAN
ORANGE
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
CAYUGA
ONTARIO
LIVINGSTON
ALLEGANY
CATTARAUGUS
CHAUTAUQUA
STEUBEN
TIOGA
CORTLAND
WAYNE
NIAGARA
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 7

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
HERKIMER
WARREN
WASHINGTON
SARATOGA
FULTON
MONTGOMERY
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
MASSACHUSETTS
GREENE
COLUMBIA
DELAWARE
ULSTER
DUTCHESS
SULLIVAN
CONNECTICUT
PUTNAM
ORANGE
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 7

NEW YORK STATE DEPARTMENT OF HEALTH

TRANSPORTATION SYSTEMS

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

EXISTING		PROPOSED
	HIGHWAYS	
━━━	CONTROLLED ACCESS HIGHWAYS	━ ━ ━ ━
═══	OTHER DIVIDED HIGHWAYS	═ ═ ═ ═
───	PRINCIPAL THROUGH HIGHWAYS	─ ─ ─ ─
───	OTHER HIGHWAYS	- - - -
━━═	INTERCHANGES	━ ━ ━ ═
	RAILWAYS	
++++++++++ (PASS. & FREIGHT)	MAJOR RAIL LINES	+++ ++ +++ (FREIGHT)
	WATERWAYS	
············	MAJOR NAVIGABLE WATERWAYS	✱✱✱✱✱✱ (RECONSTRUCTED)
⬢	PORTS	⬡

SOURCE: DEPARTMENT OF TRANSPORTATION; POLICIES AND PLANS FOR TRANSPORTATION IN NEW YORK STATE

DATE: AUGUST, 1969

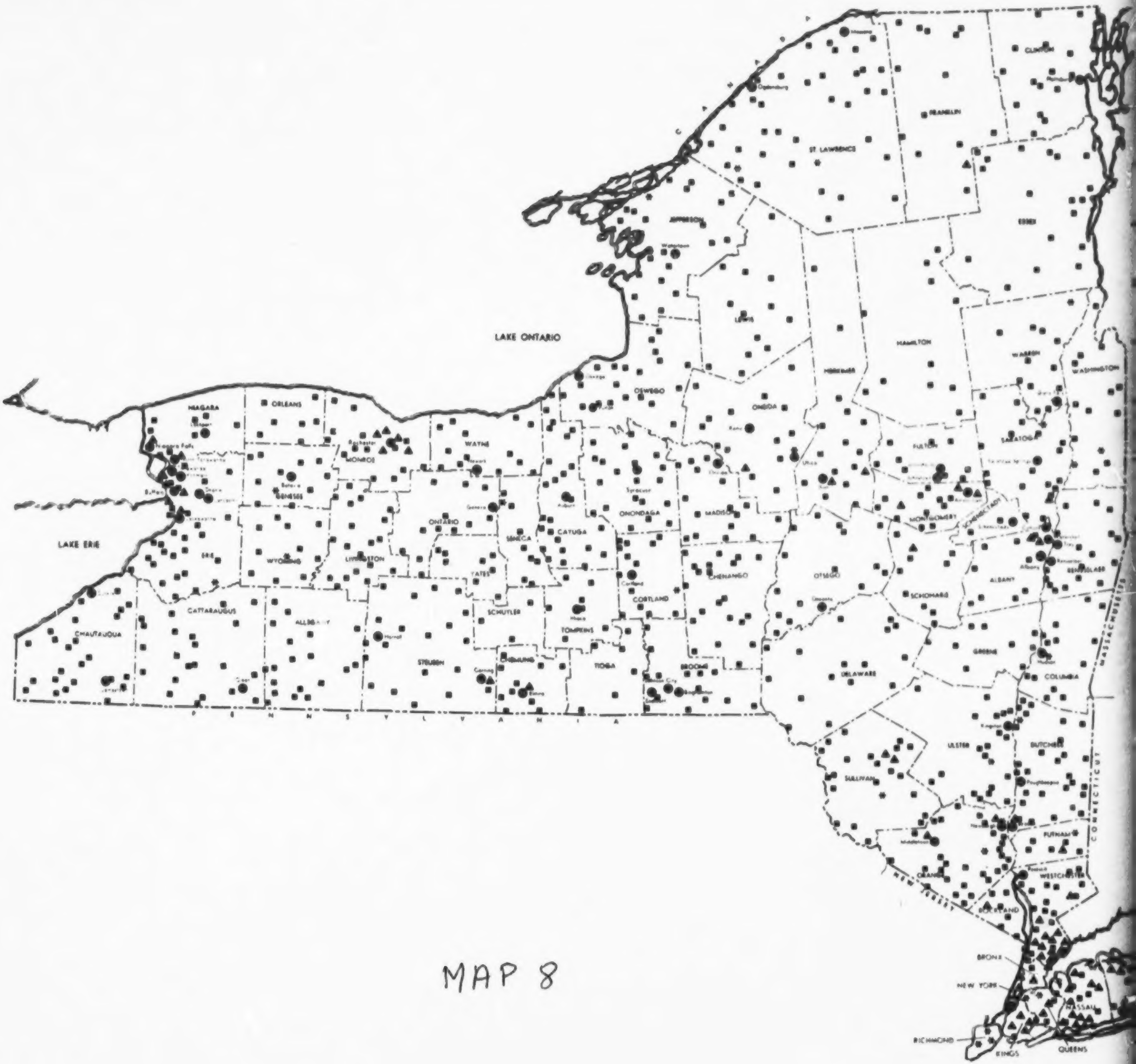
SCALE IN MILES

10 0 10 20 30 40 50 60 70

N

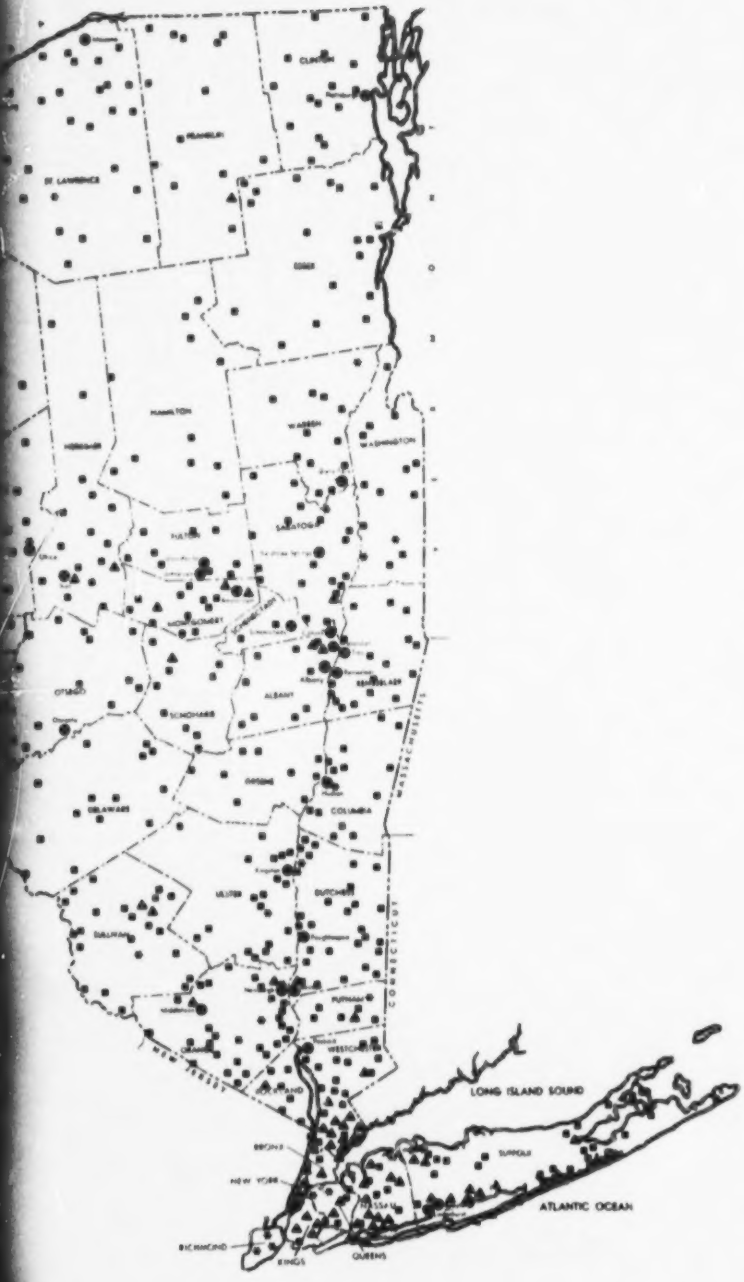
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
ST LAWRENCE
FRANKLIN
CLINTON
ESSEX
JEFFERSON
LEWIS
HAMILTON
WARREN
WASHINGTON
HERKIMER
ONEIDA
OSWEGO
NIAGARA
ORLEANS
MONROE
WAYNE
GENESEE
ERIE
WYOMING
LIVINGSTON
ONTARIO
SENECA
CAYUGA
ONONDAGA
MADISON
FULTON
SARATOGA
MONTGOMERY
SCHENECTADY
ALBANY
RENSSELAER
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
YATES
SCHUYLER
TOMPKINS
CORTLAND
CHENANGO
OTSEGO
SCHOHARIE
CHEMUNG
TIOGA
BROOME
DELAWARE
GREENE
COLUMBIA
ULSTER
SULLIVAN
DUTCHESS
ORANGE
PUTNAM
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NASSAU

MAP 8

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
HERKIMER
WARREN
WASHINGTON
FULTON
SARATOGA
MONTGOMERY
SCHENECTADY
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
GREENE
COLUMBIA
MASSACHUSETTS
DELAWARE
ULSTER
DUTCHESS
SULLIVAN
CONNECTICUT
ORANGE
PUTNAM
NEW JERSEY
ROCKLAND
WESTCHESTER
LONG ISLAND SOUND
BRONX
NEW YORK
SUFFOLK
NASSAU
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 8

NEW YORK STATE DEPARTMENT OF HEALTH

EXISTING DISPOSAL SITES

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

▲ INCINERATOR

LAND DISPOSAL AREA

* ≥ 100 ACRES, > 5 YEARS LIFE

■ < 100 ACRES OR ≤ 5 YEARS LIFE

SOURCE: RECORDS AND INVESTIGATIONS OF THE NEW YORK STATE DEPARTMENT OF HEALTH

DATE: AUGUST, 1969

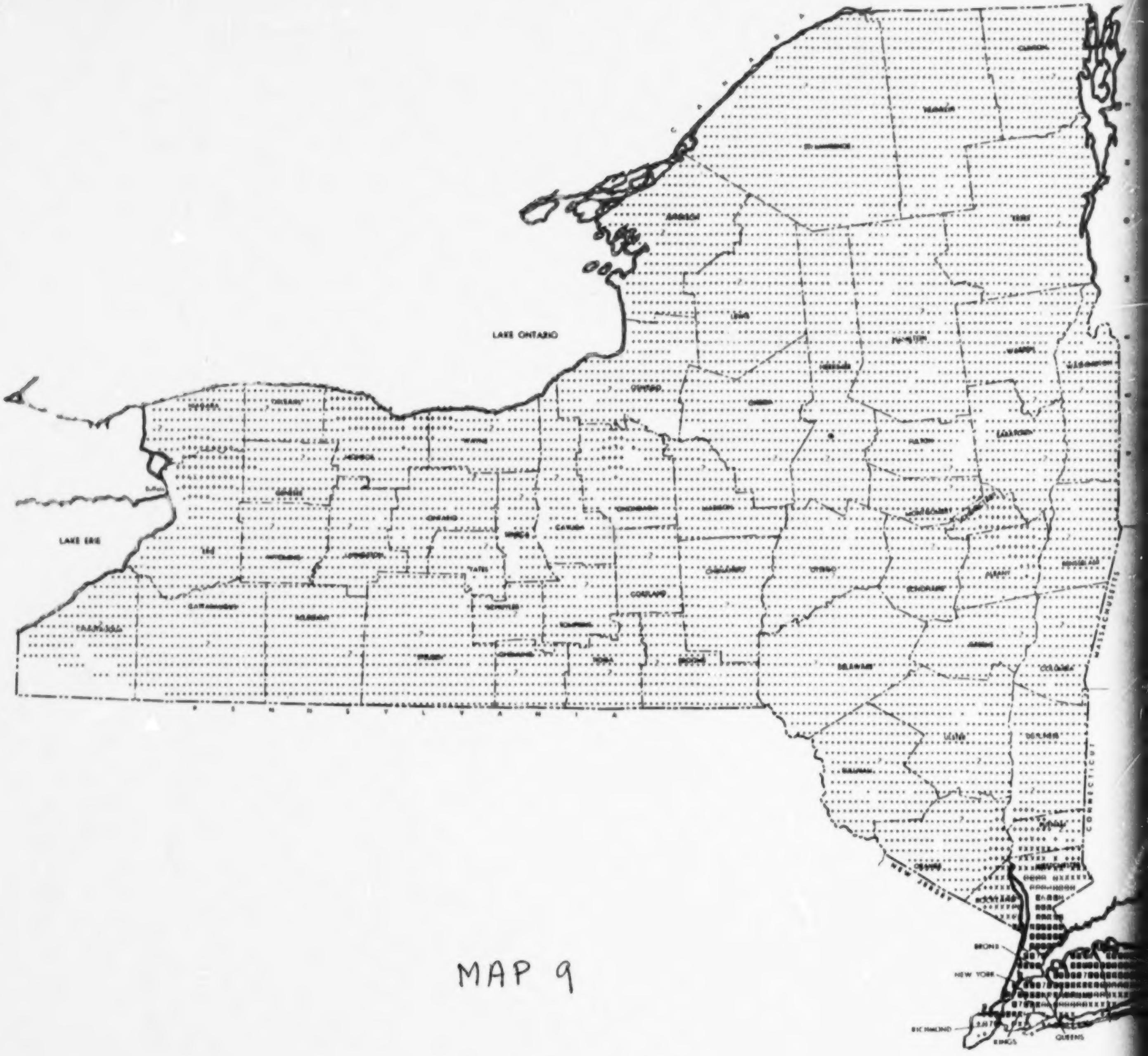
N

SCALE IN MILES

10 0 10 20 30 40 50 60 70

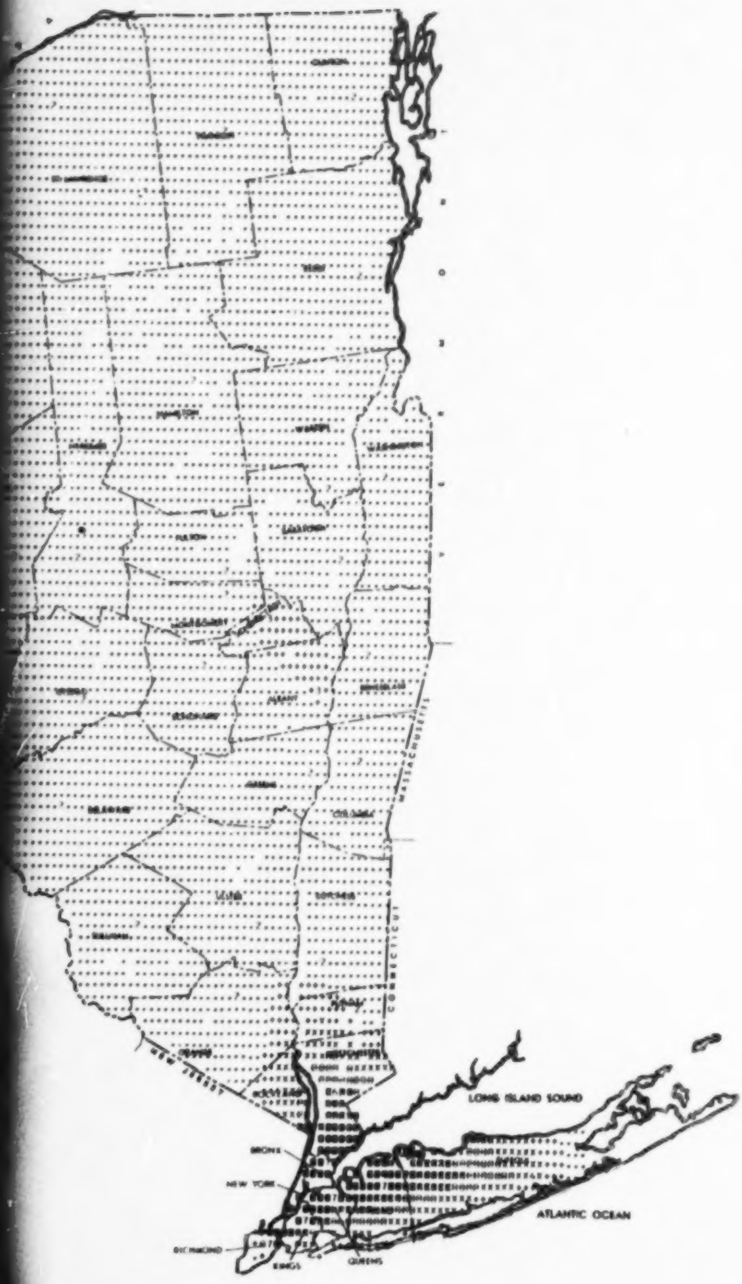
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

13


LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 9

A


NEW JERSEY
CONNECTICUT
MASSACHUSETTS
LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 9

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL WASTE DENSITY 1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

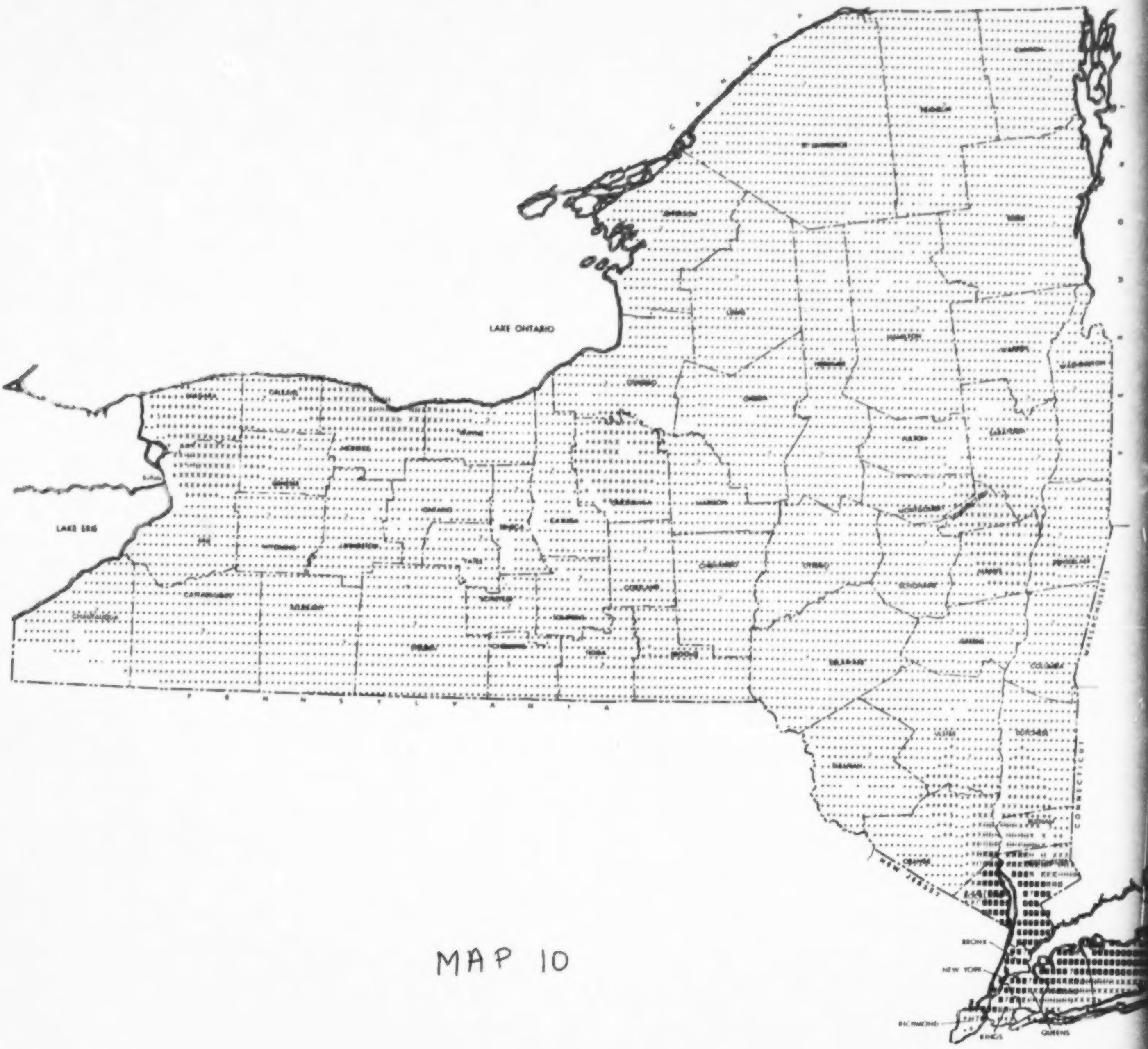
LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	░	59	0.1 — 400.0
3	░	3	400.1 — 800.0
4	▒	4	800.1 — 1200.0
5	▒	0	1200.1 — 1600.0
6	▓	1	1600.1 — 2000.0
7	■	6	2000.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N
SCALE IN MILES
10
0
10
20
30
40
50
60
70

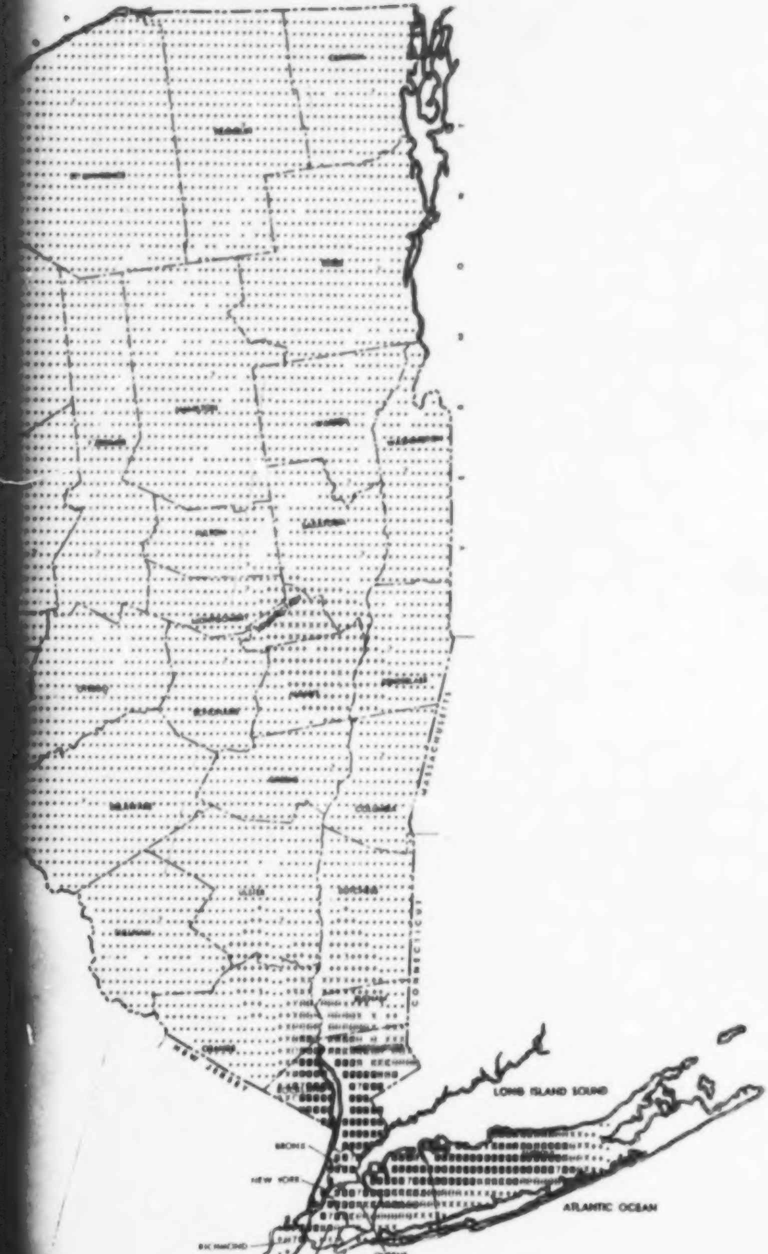
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
ONTARIO
CORTLAND
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 10

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 10

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL WASTE DENSITY 1985

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

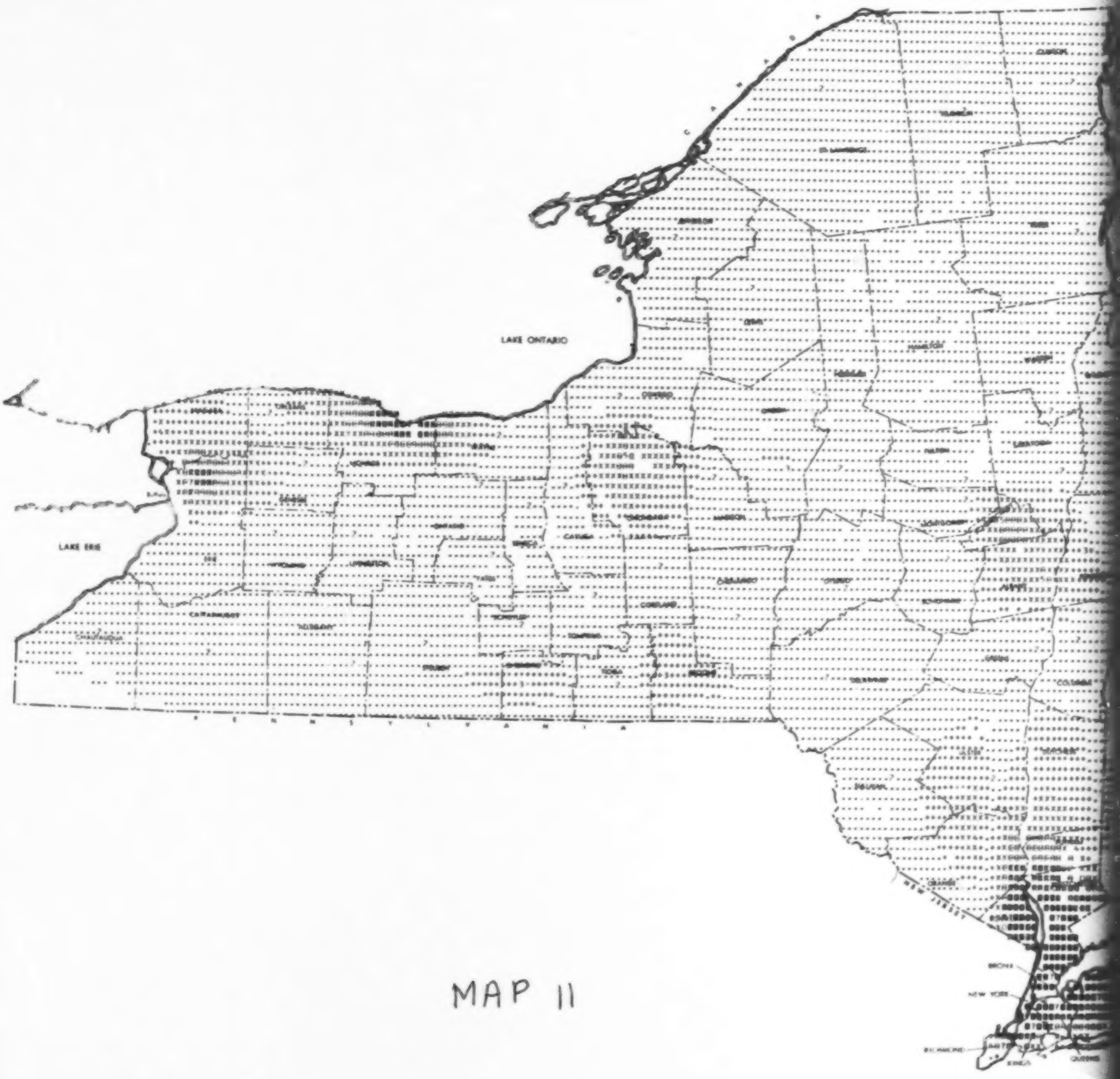
LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	░	53	0.1 — 400.0
3	░	6	400.1 — 800.0
4	░	3	800.1 — 1200.0
5	▒	2	1200.1 — 1600.0
6	▒	0	1600.1 — 2000.0
7	▓	9	2000.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

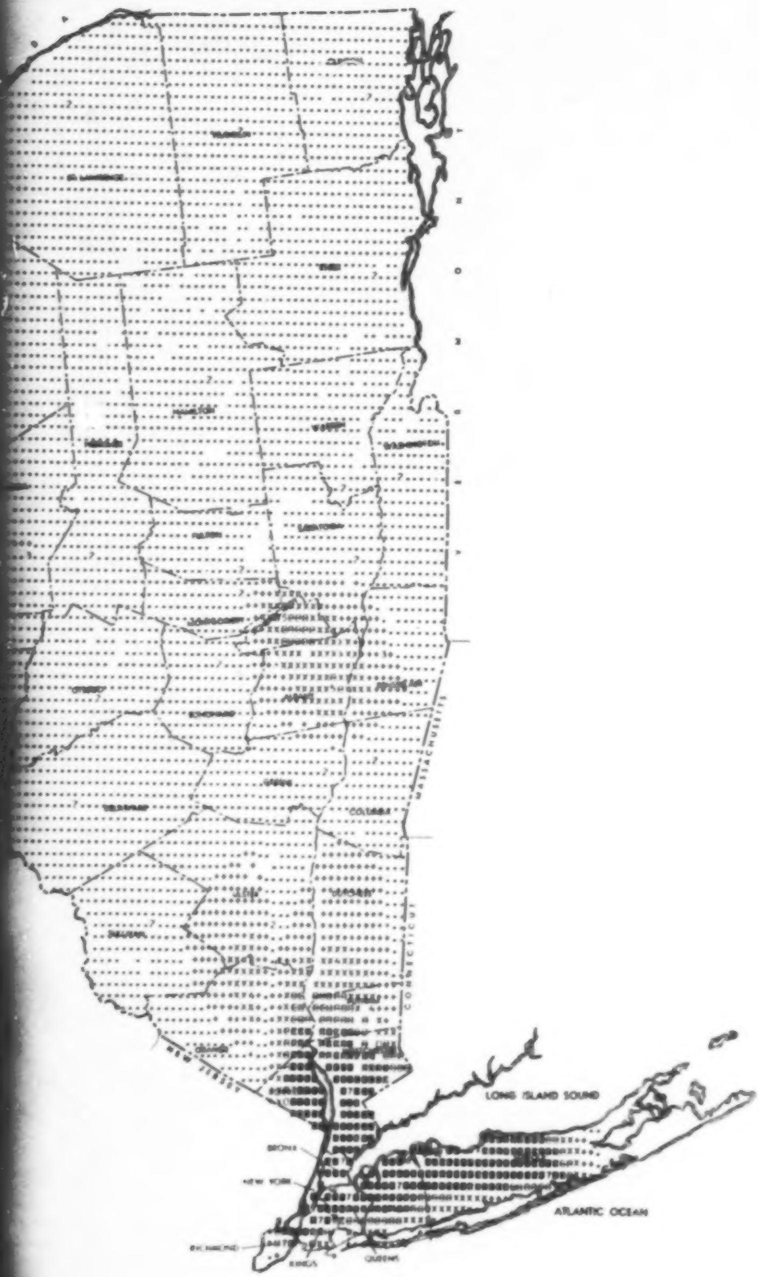
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
CLINTON
ST. LAWRENCE
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
CORTLAND
ORANGE
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
PENNSYLVANIA
NEW JERSEY

MAP 11

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 11

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL WASTE DENSITY 1995

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	░	49	0.1 — 400.0
3	░	6	400.1 — 800.0
4	▒	4	800.1 — 1200.0
5	▒	3	1200.1 — 1600.0
6	▓	0	1600.1 — 2000.0
7	●	11	2000.1 AND OVER

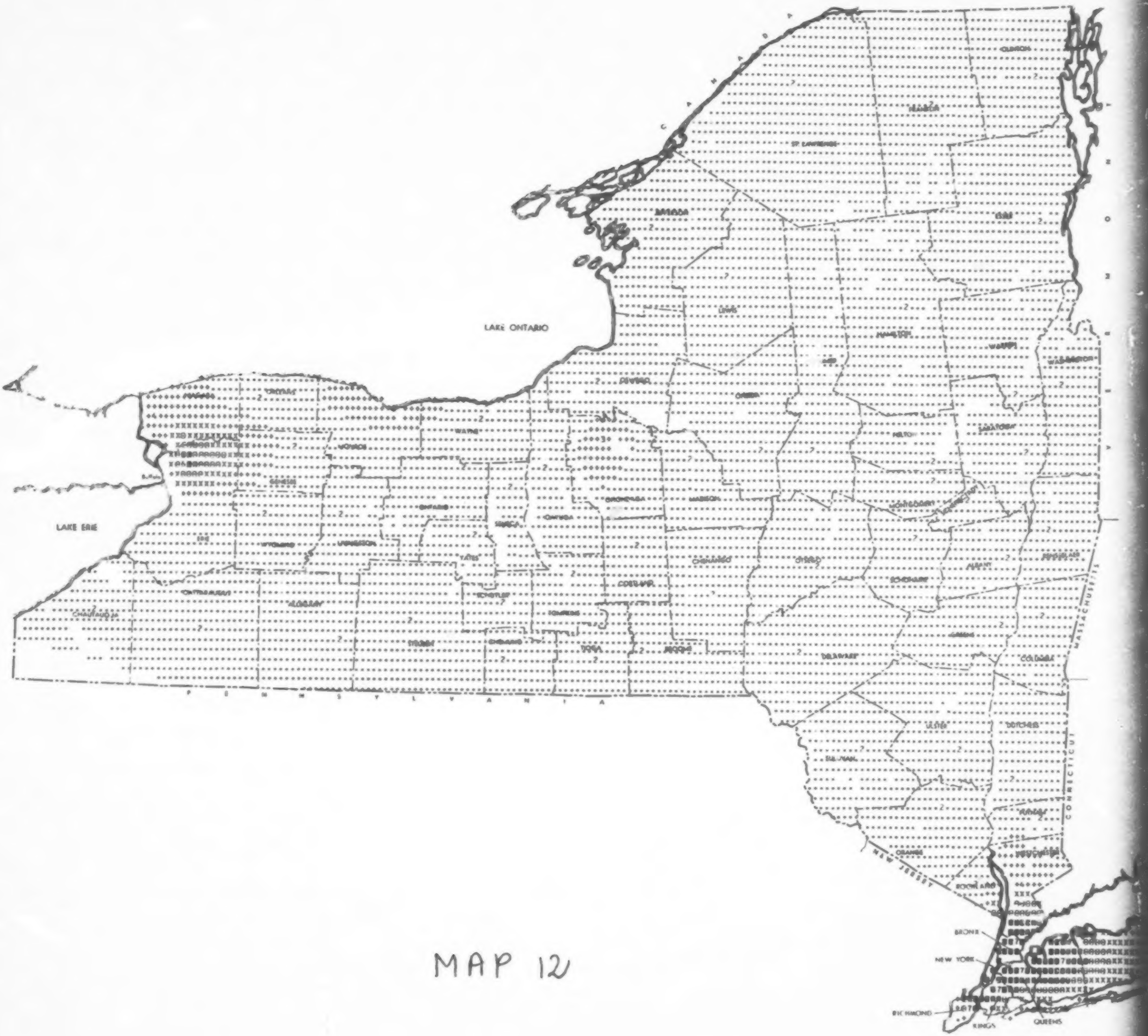
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

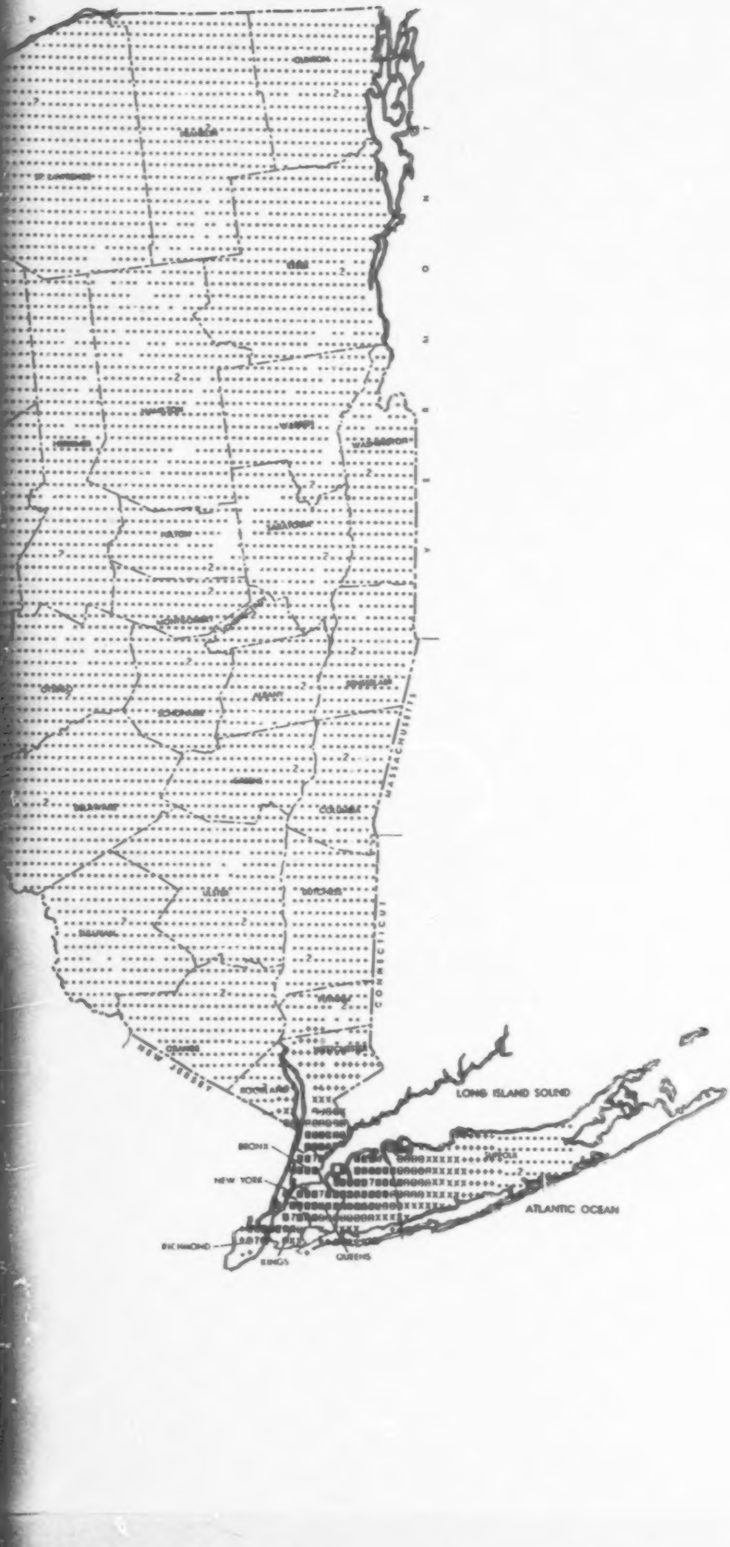
THE PREPARATION OF THIS MAP WAS [illegible] PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
Buffalo
NIAGARA
ORLEANS
MONROE
WAYNE
GENESEE
ERIE
WYOMING
LIVINGSTON
ONTARIO
YATES
SENECA
CAYUGA
ONONDAGA
OSWEGO
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
SCHUYLER
CHEMUNG
TOMPKINS
TIOGA
CORTLAND
BROOME
JEFFERSON
ST. LAWRENCE
FRANKLIN
CLINTON
ESSEX
LEWIS
HERKIMER
HAMILTON
WARREN
WASHINGTON
ONEIDA
MADISON
FULTON
SARATOGA
MONTGOMERY
SCHENECTADY
CHENANGO
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
ROCKLAND
WESTCHESTER
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 12

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
SUFFOLK
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
CLINTON
ESSEX
ST LAWRENCE
HAMILTON
WARREN
WASHINGTON
SARATOGA
FULTON
ALBANY
SCHOHARIE
OTSEGO
DELAWARE
COLUMBIA
GREENE
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
ROCKLAND
WESTCHESTER

MAP 12

NEW YORK STATE DEPARTMENT OF HEALTH

INDUSTRIAL WASTE DENSITY 1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	⋯	62	0.1 — 203.4
3	⁘	2	203.5 — 406.8
4	×	2	406.9 — 610.2
5	-	0	610.3 — 813.6
6	X	1	813.7 — 1017.0
7	■	6	1017.1 AND OVER

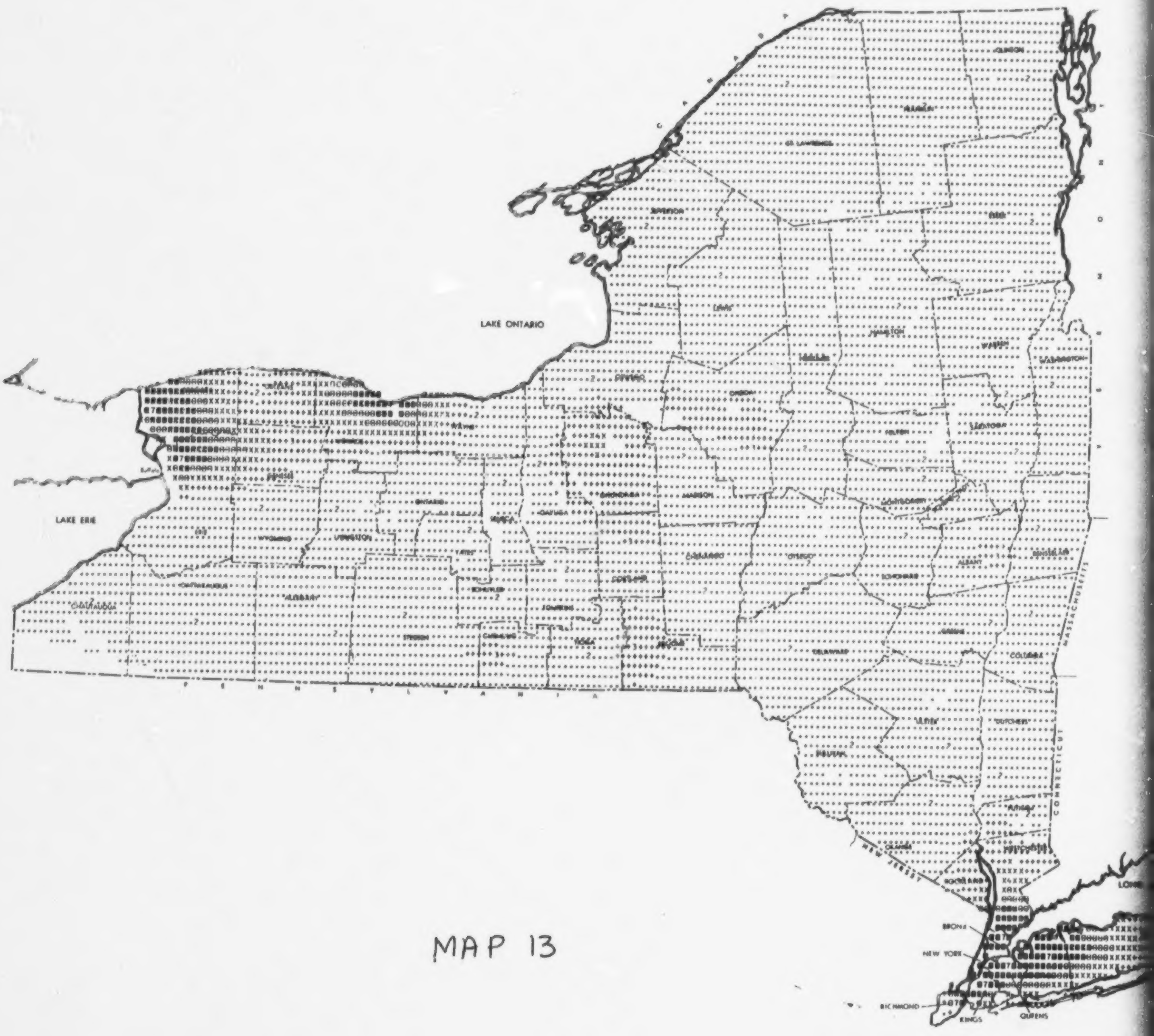
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

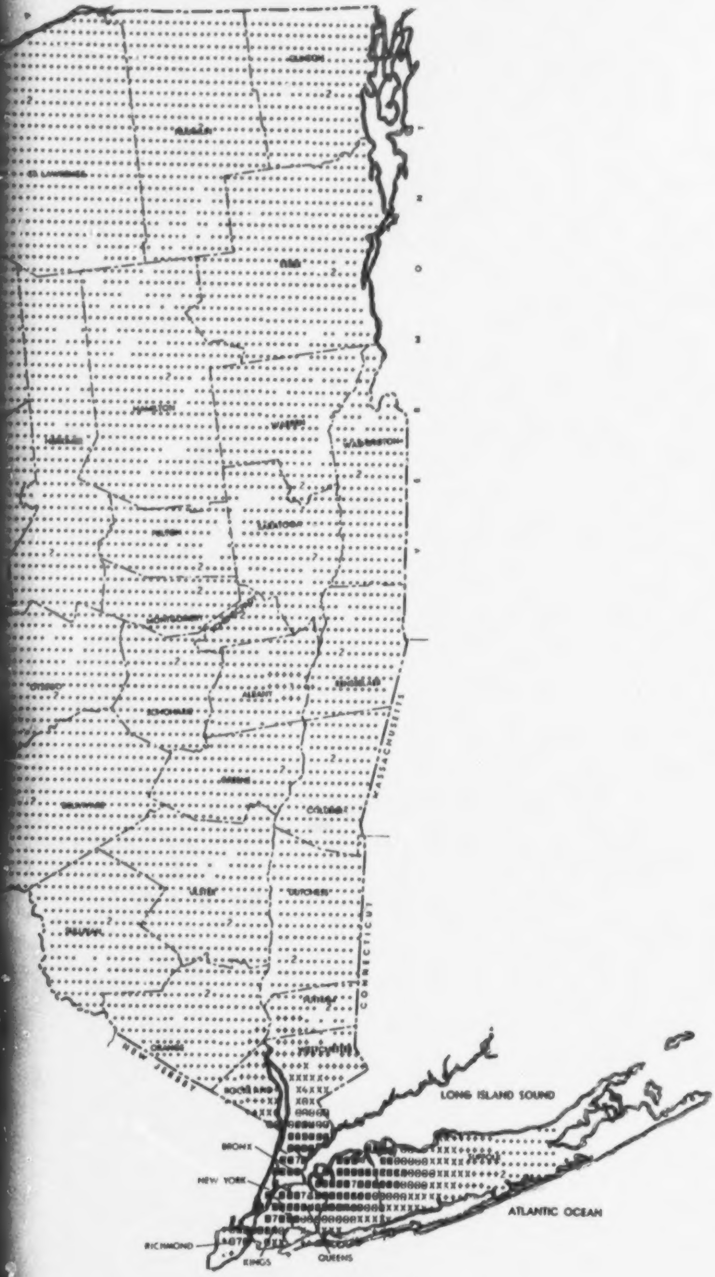
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
CLINTON
FRANKLIN
ST. LAWRENCE
JEFFERSON
ESSEX
LEWIS
HAMILTON
WARREN
WASHINGTON
OSWEGO
ONEIDA
HERKIMER
FULTON
SARATOGA
MONTGOMERY
ORLEANS
MONROE
WAYNE
GENESEE
ERIE
WYOMING
LIVINGSTON
ONTARIO
SENECA
CAYUGA
ONONDAGA
MADISON
YATES
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
CHENANGO
CORTLAND
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
SCHUYLER
TOMPKINS
CHEMUNG
TIOGA
BROOME
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
ROCKLAND
WESTCHESTER
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
VERMONT

MAP 13

A


NEW JERSEY
MASSACHUSETTS
CONNECTICUT
ROCKLAND
ORANGE
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 13

NEW YORK STATE DEPARTMENT OF HEALTH

INDUSTRIAL WASTE DENSITY 1985

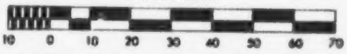
STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	∷	53	0.1 — 203.4
3	⁙	9	203.5 — 406.8
4	▒	2	406.9 — 610.2
5	▤	0	610.3 — 813.6
6	▦	0	813.7 — 1017.0
7	■	9	1017.1 AND OVER

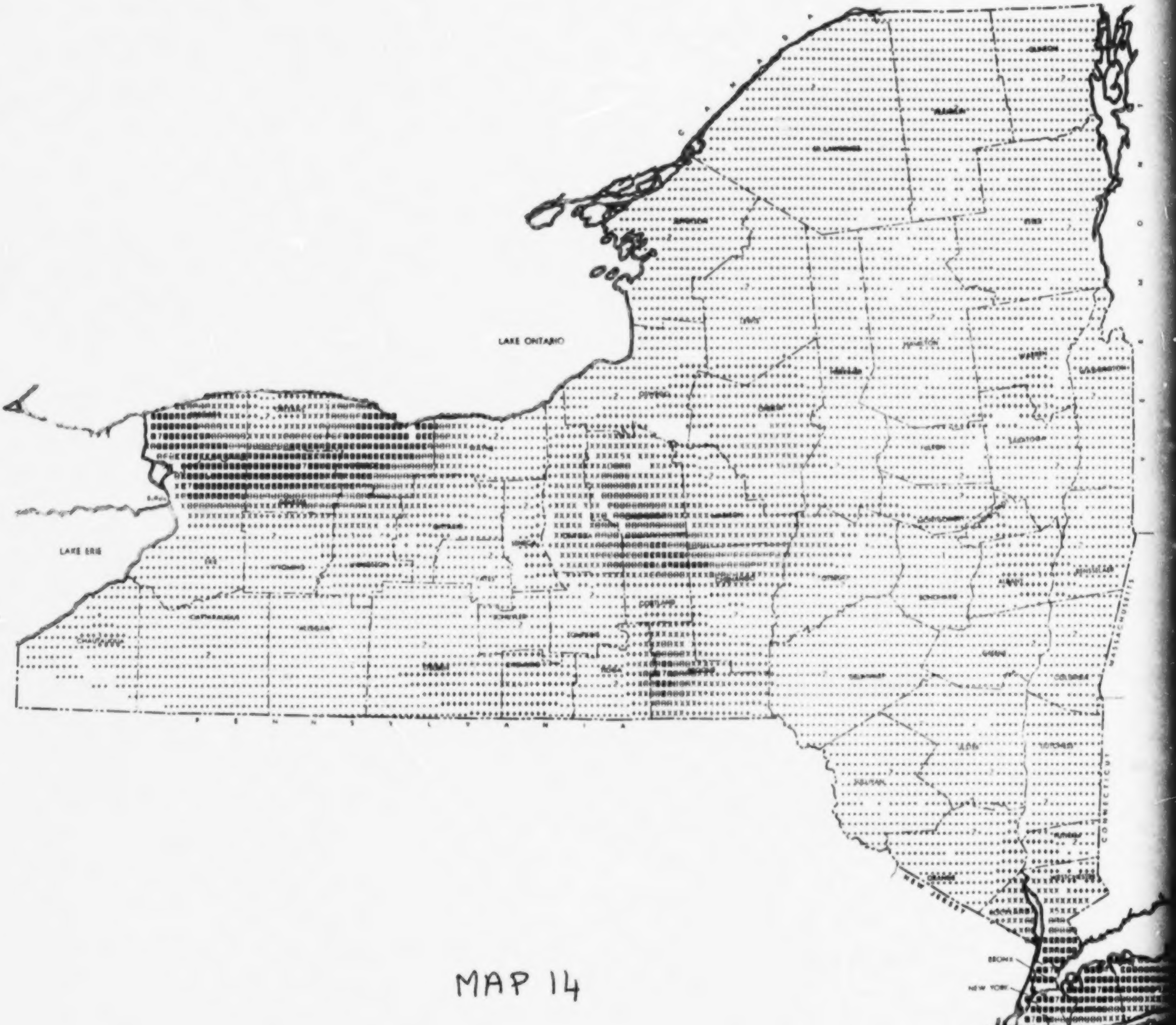
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES


10
0
10
20
30
40
50
60
70

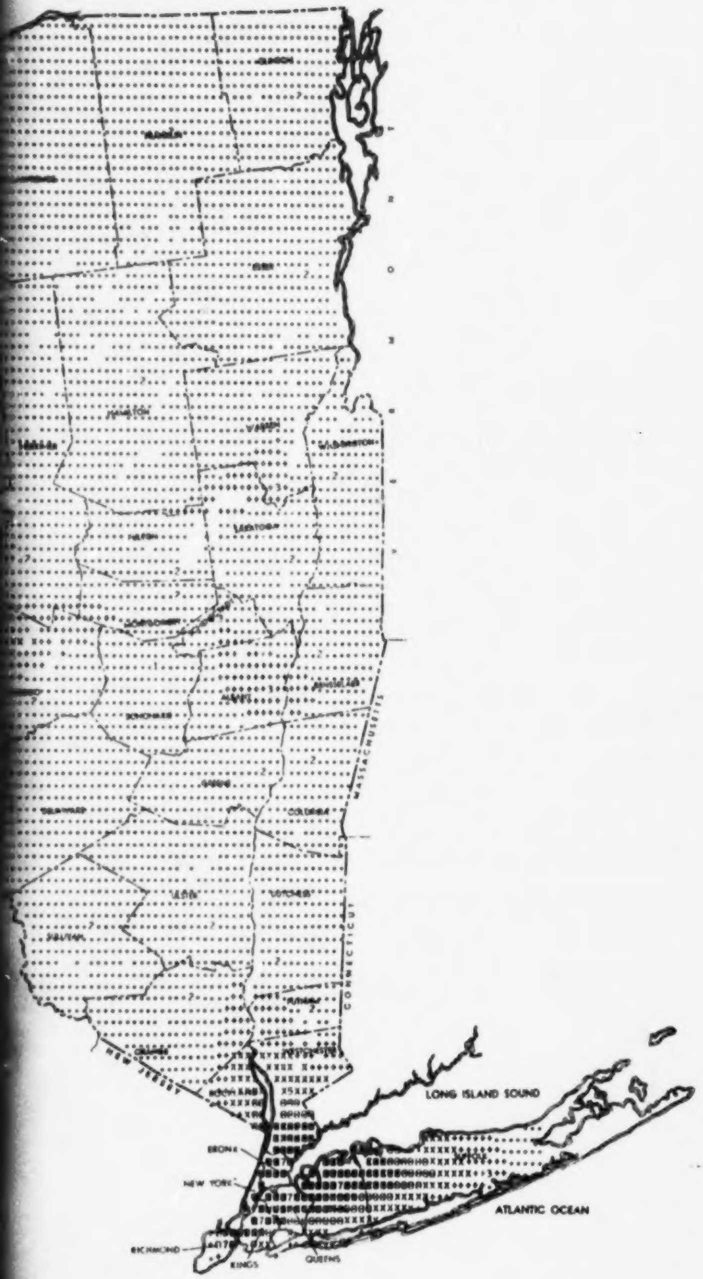
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
CORTLAND
P E N N S Y L V A N I A
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 14

A


MASSACHUSETTS
CONNECTICUT
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 14

NEW YORK STATE DEPARTMENT OF HEALTH

INDUSTRIAL WASTE DENSITY 1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	'	67	0.0 — 0.1
2	⋯	42	0.1 — 203.4
3	⁙	9	203.5 — 406.8
4	░	6	406.9 — 610.2
5	▒	2	610.3 — 813.6
6	▓	3	813.7 — 1017.0
7	■	11	1017.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

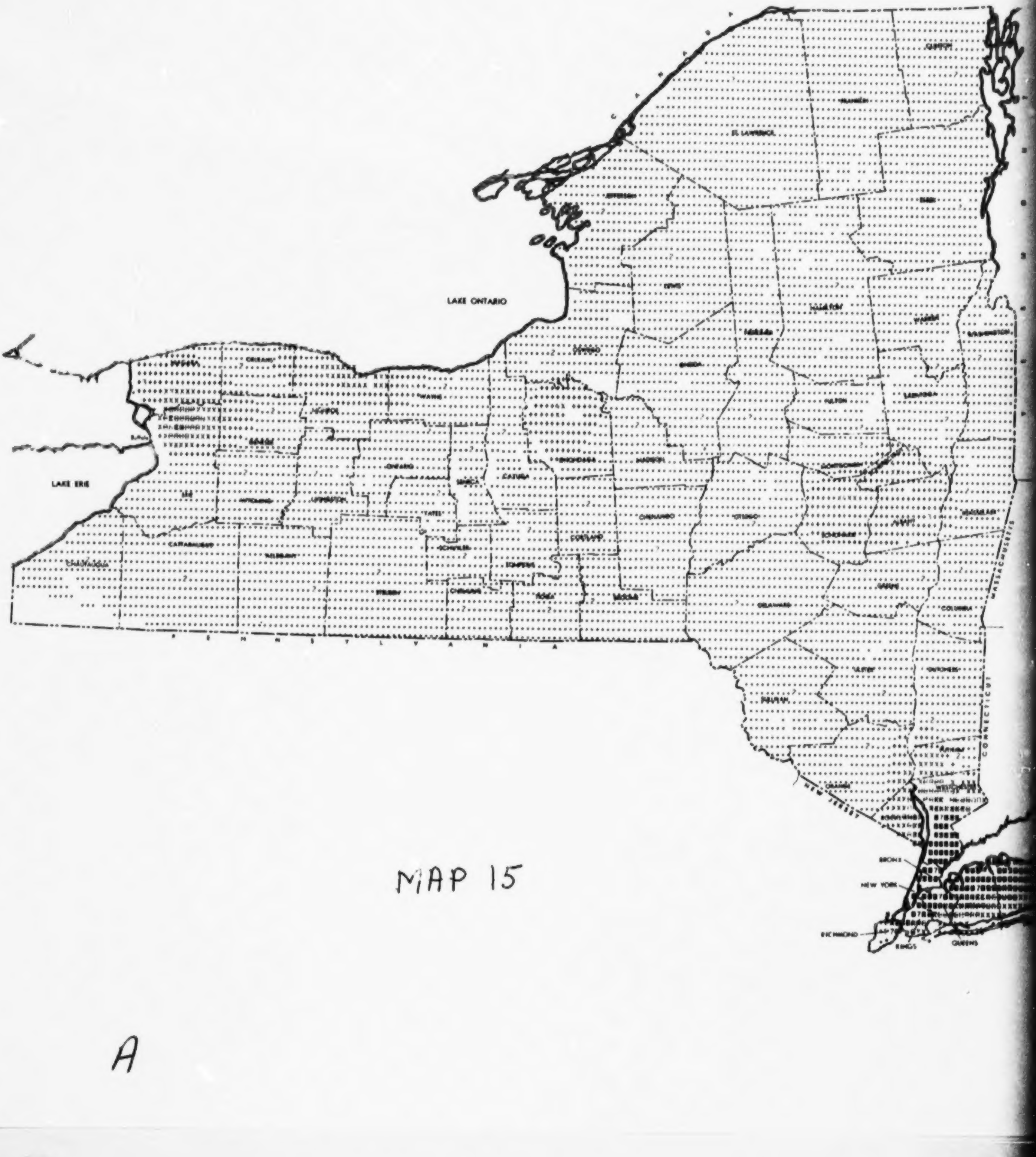
N

SCALE IN MILES

10 0 10 20 30 40 50 60 70

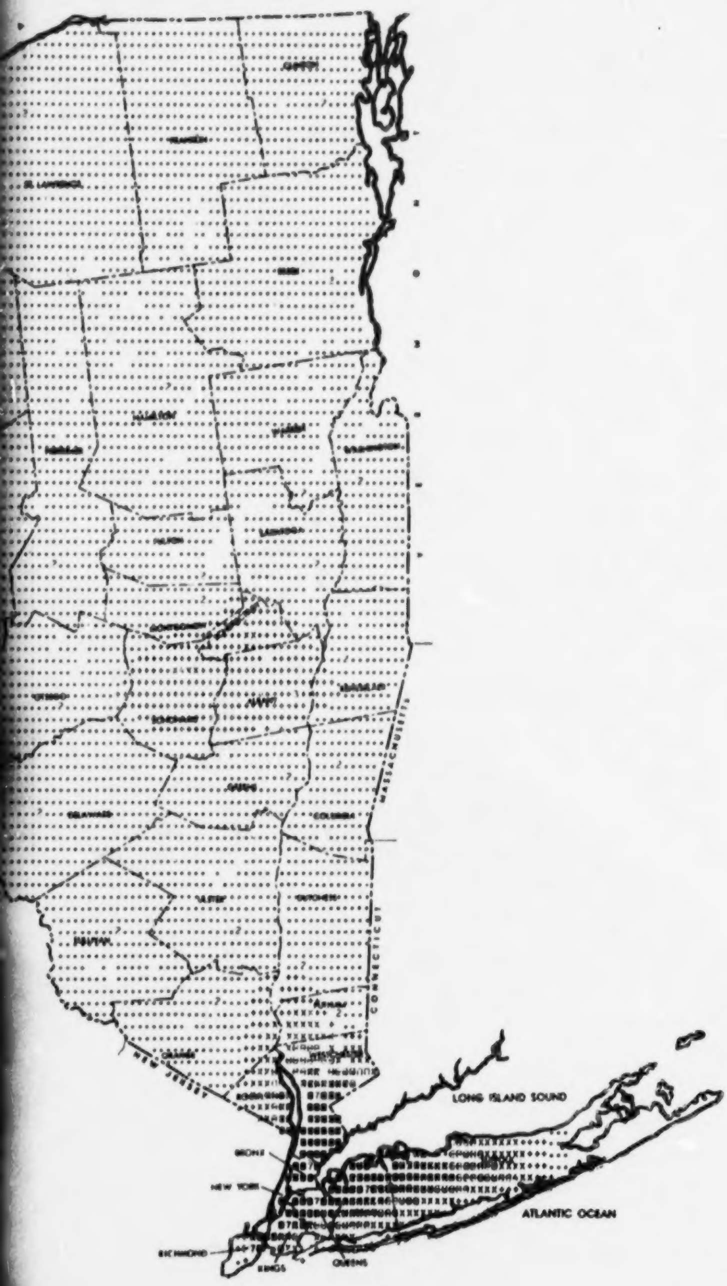
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
ST. LAWRENCE
FRANKLIN
CLINTON
JEFFERSON
ESSEX
LEWIS
HAMILTON
WARREN
LAKE ONTARIO
OSWEGO
ONEIDA
HERKIMER
WASHINGTON
SARATOGA
FULTON
NIAGARA
ORLEANS
MONROE
WAYNE
GENESEE
ONONDAGA
MADISON
LAKE ERIE
ERIE
WYOMING
LIVINGSTON
ONTARIO
SENECA
CAYUGA
YATES
CHENANGO
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
CATTARAUGUS
CHAUTAUQUA
ALLEGANY
SCHUYLER
TOMPKINS
CORTLAND
STEUBEN
CHEMUNG
TIOGA
BROOME
DELAWARE
GREENE
COLUMBIA
MASSACHUSETTS
PENNSYLVANIA
ULSTER
DUTCHESS
SULLIVAN
PUTNAM
CONNECTICUT
ORANGE
NEW JERSEY
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 15

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 15

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL & INDUSTRIAL WASTE DENSITY 1970

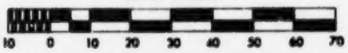
STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	⋯	57	0.1 — 400.0
3	░	2	400.1 — 800.0
4	▒	5	800.1 — 1200.0
5	▓	1	1200.1 — 1600.0
6	▨	1	1600.1 — 2000.0
7	■	7	2000.1 AND OVER

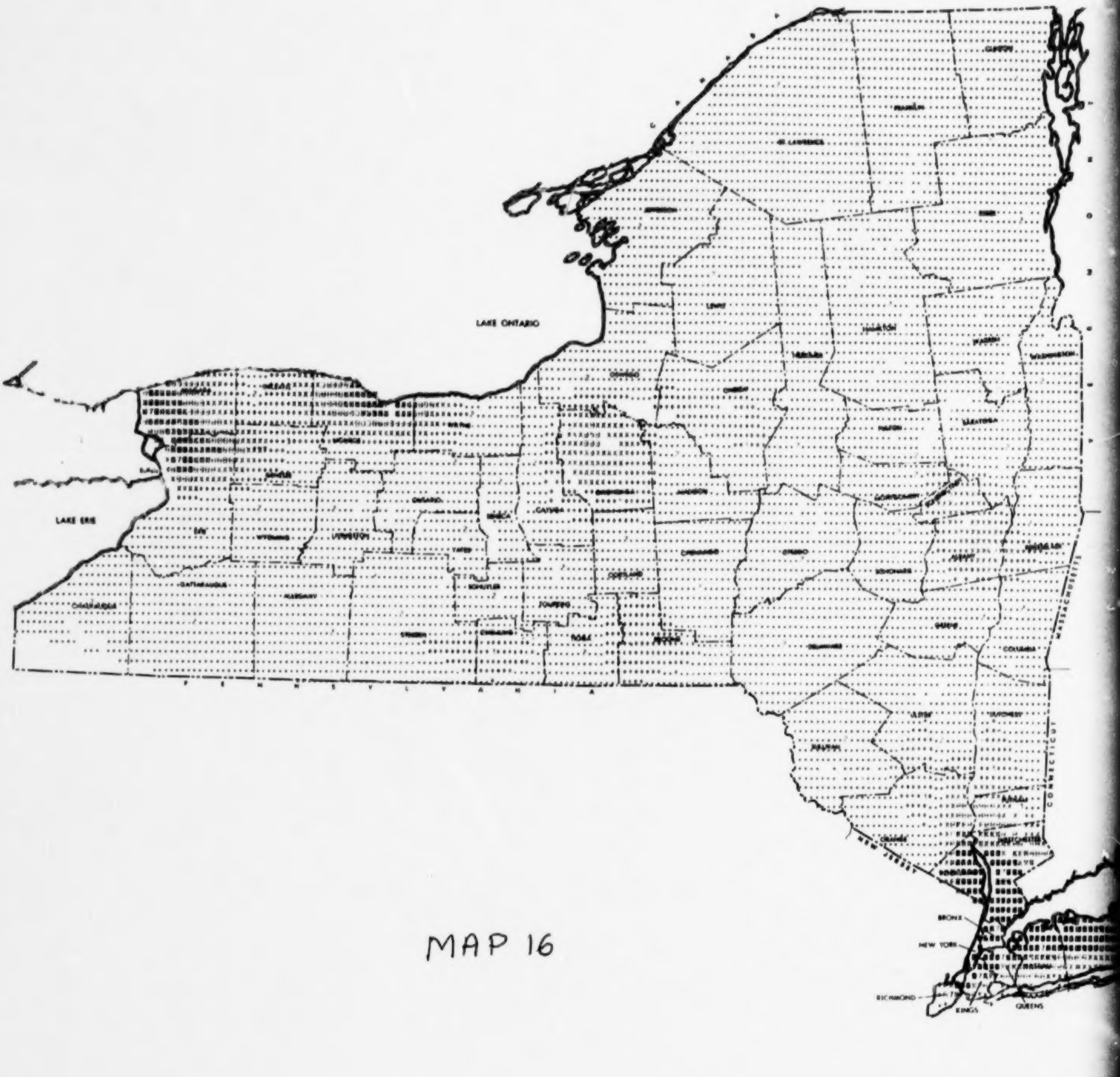
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES


10
0
10
20
30
40
50
60
70

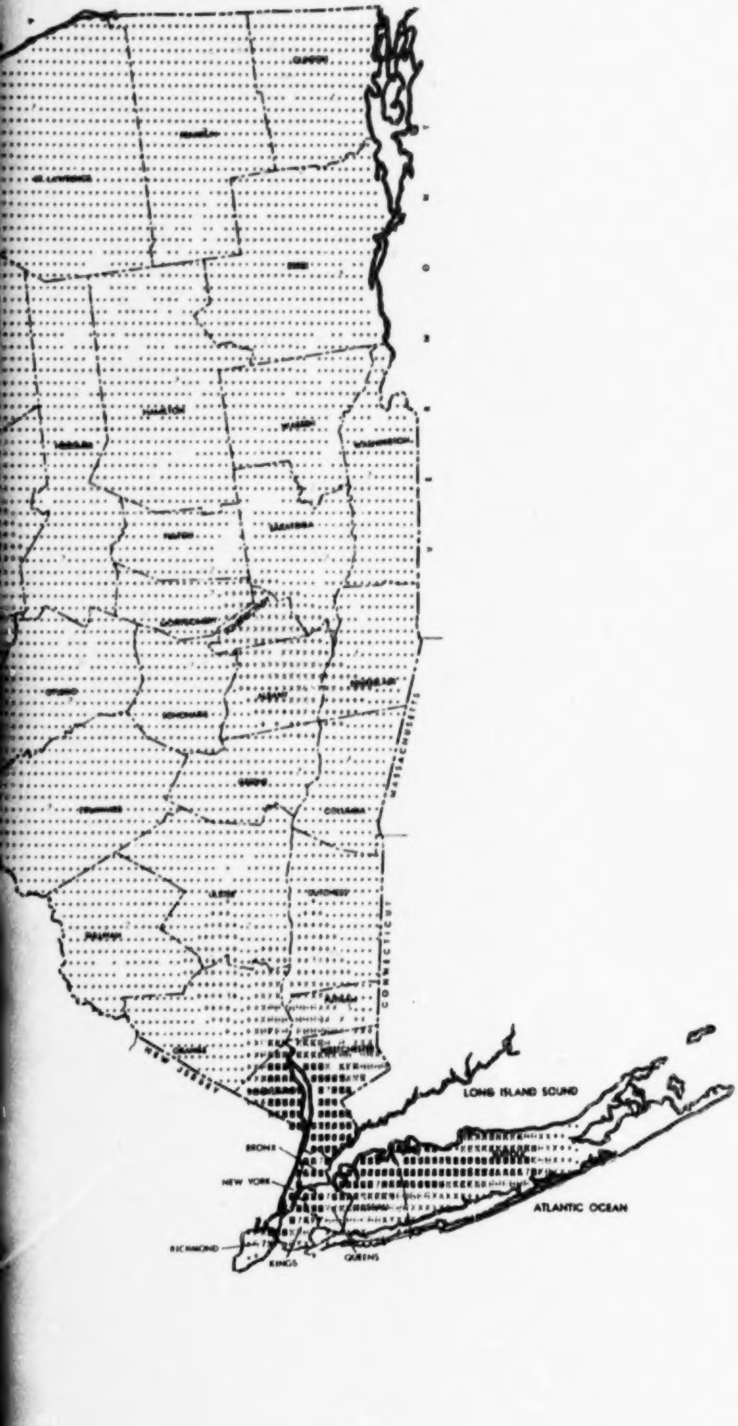
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
ST. LAWRENCE
FRANKLIN
CLINTON
LEWIS
HAMILTON
WASHINGTON
SARATOGA
FULTON
CAYUGA
ONTARIO
LIVINGSTON
WYOMING
ERIE
YATES
CATTARAUGUS
CHAUTAUQUA
ALLEGANY
STEUBEN
SCHUYLER
CHEMUNG
TOMPKINS
TIOGA
CORTLAND
CHENANGO
BROOME
OTSEGO
DELAWARE
SCHOHARIE
ALBANY
RENSSELAER
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
P E N N S Y L V A N I A
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 16

A


ST. LAWRENCE
WASHINGTON
COLUMBIA
DUTCHESS
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
ATLANTIC OCEAN

MAP 16

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL & INDUSTRIAL WASTE DENSITY 1985

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	░	47	0.1 — 400.0
3	░	10	400.1 — 800.0
4	▒	2	800.1 — 1200.0
5	▒	2	1200.1 — 1600.0
6	▓	0	1600.1 — 2000.0
7	▦	12	2000.1 AND OVER

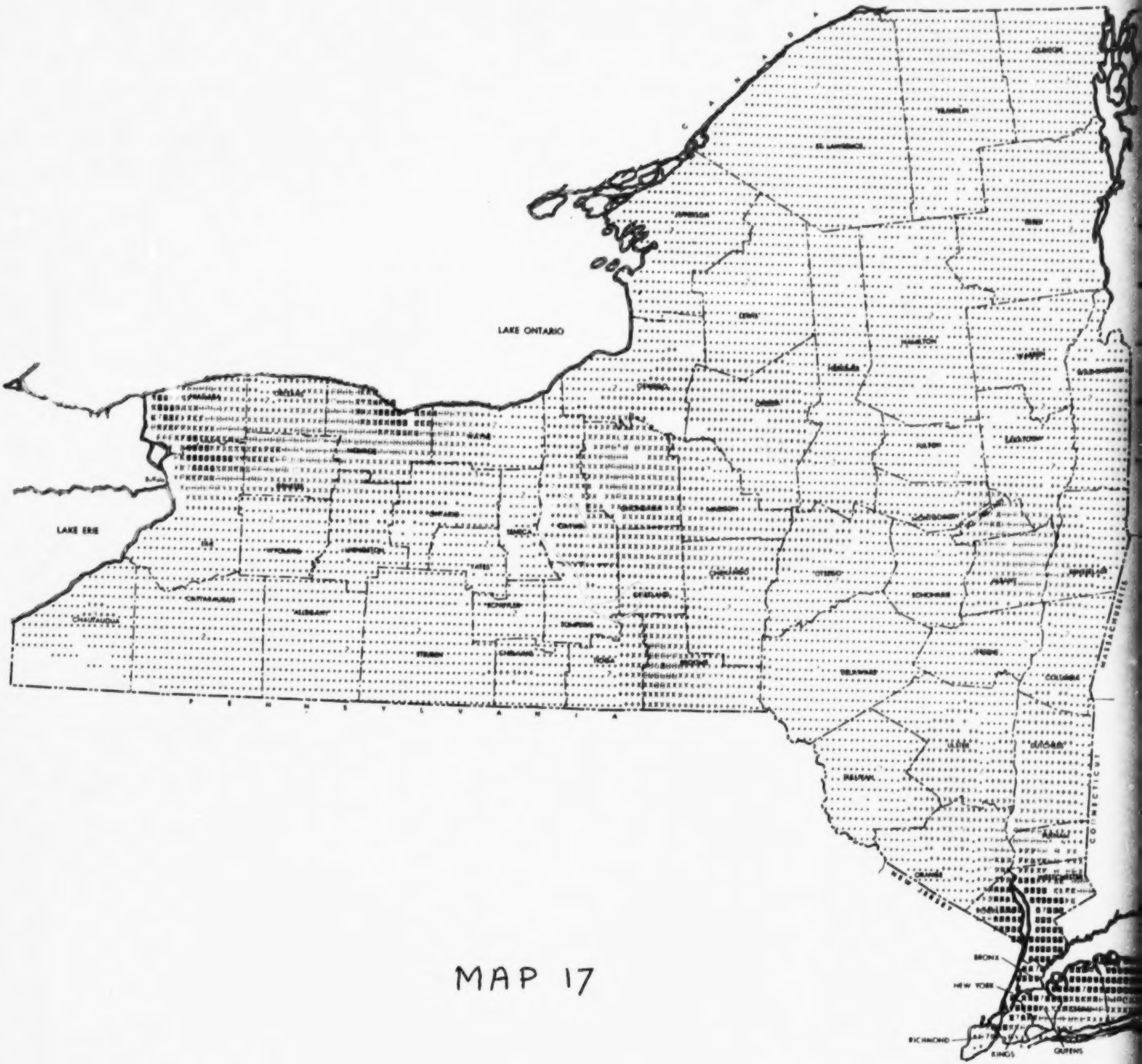
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

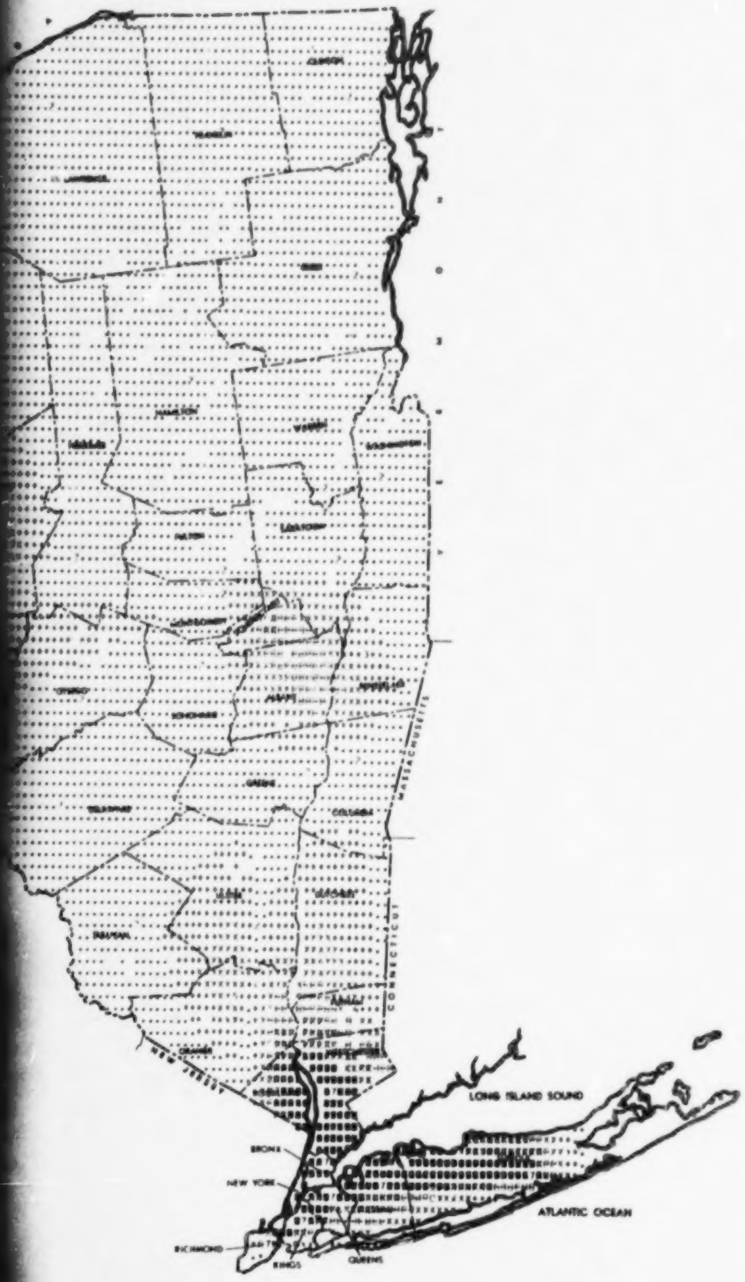
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 17

A


LONG ISLAND SOUND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
ATLANTIC OCEAN
NEW JERSEY
MASSACHUSETTS
CONNECTICUT

MAP 17

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL & INDUSTRIAL WASTE DENSITY 1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	67	0.0 — 0.1
2	░	38	0.1 — 400.0
3	░	9	400.1 — 800.0
4	░	8	800.1 — 1200.0
5	▒	3	1200.1 — 1600.0
6	▓	3	1600.1 — 2000.0
7	■	12	2000.1 AND OVER

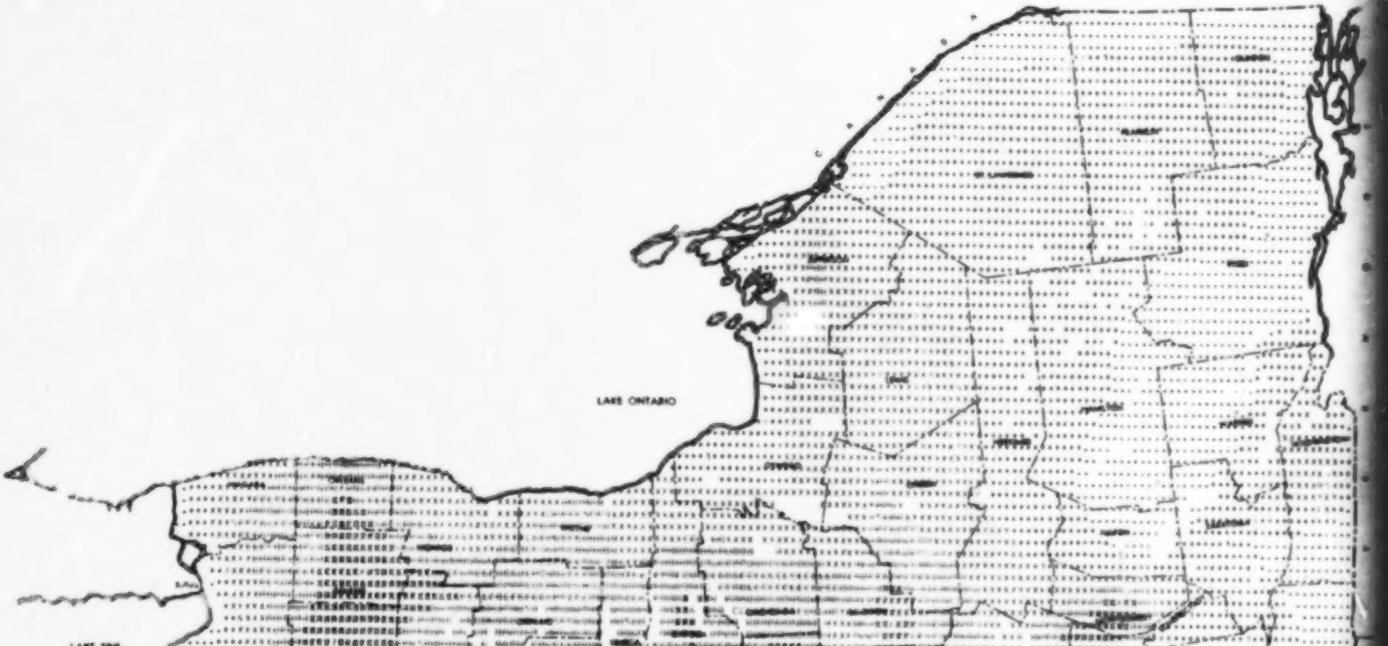
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

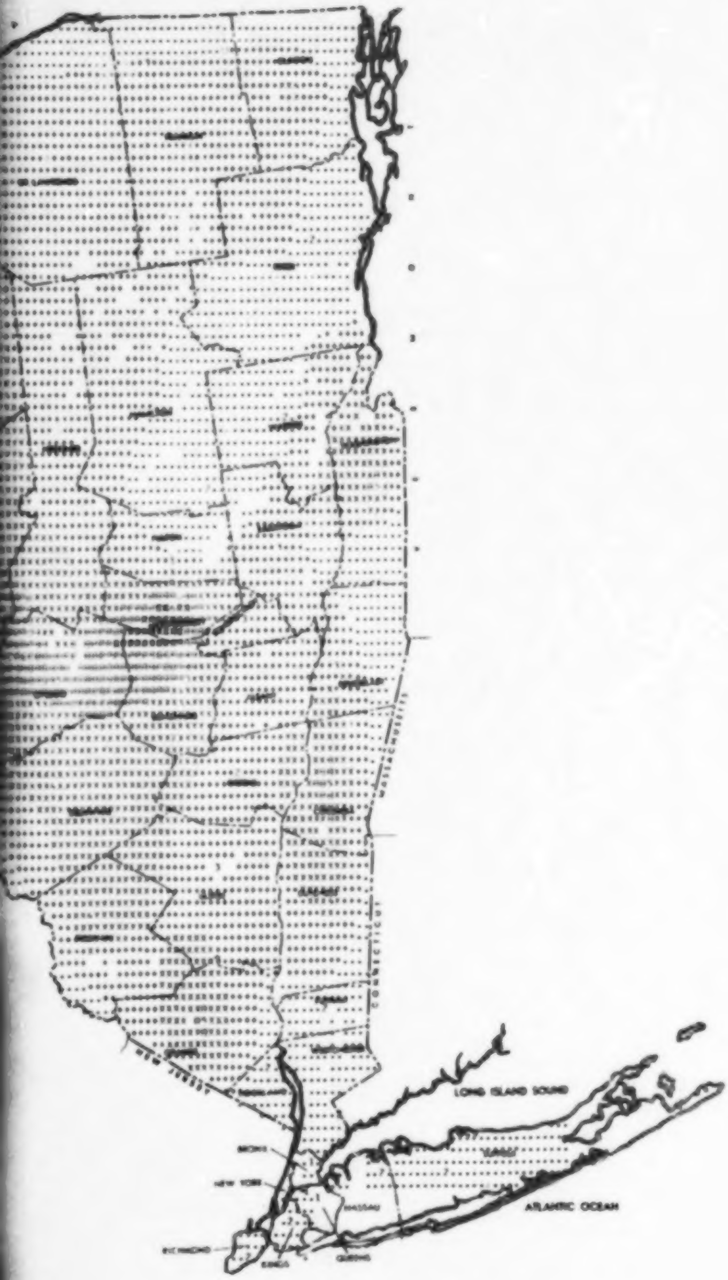
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
BRONX
NEW YORK
NASSAU
RICHMOND
KINGS
QUEENS

MAP 18

A


NEW JERSEY
LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NASSAU
SUFFOLK
CONNECTICUT
MASSACHUSETTS

MAP 18

NEW YORK STATE DEPARTMENT OF HEALTH

AGRICULTURAL WASTE DENSITY 1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

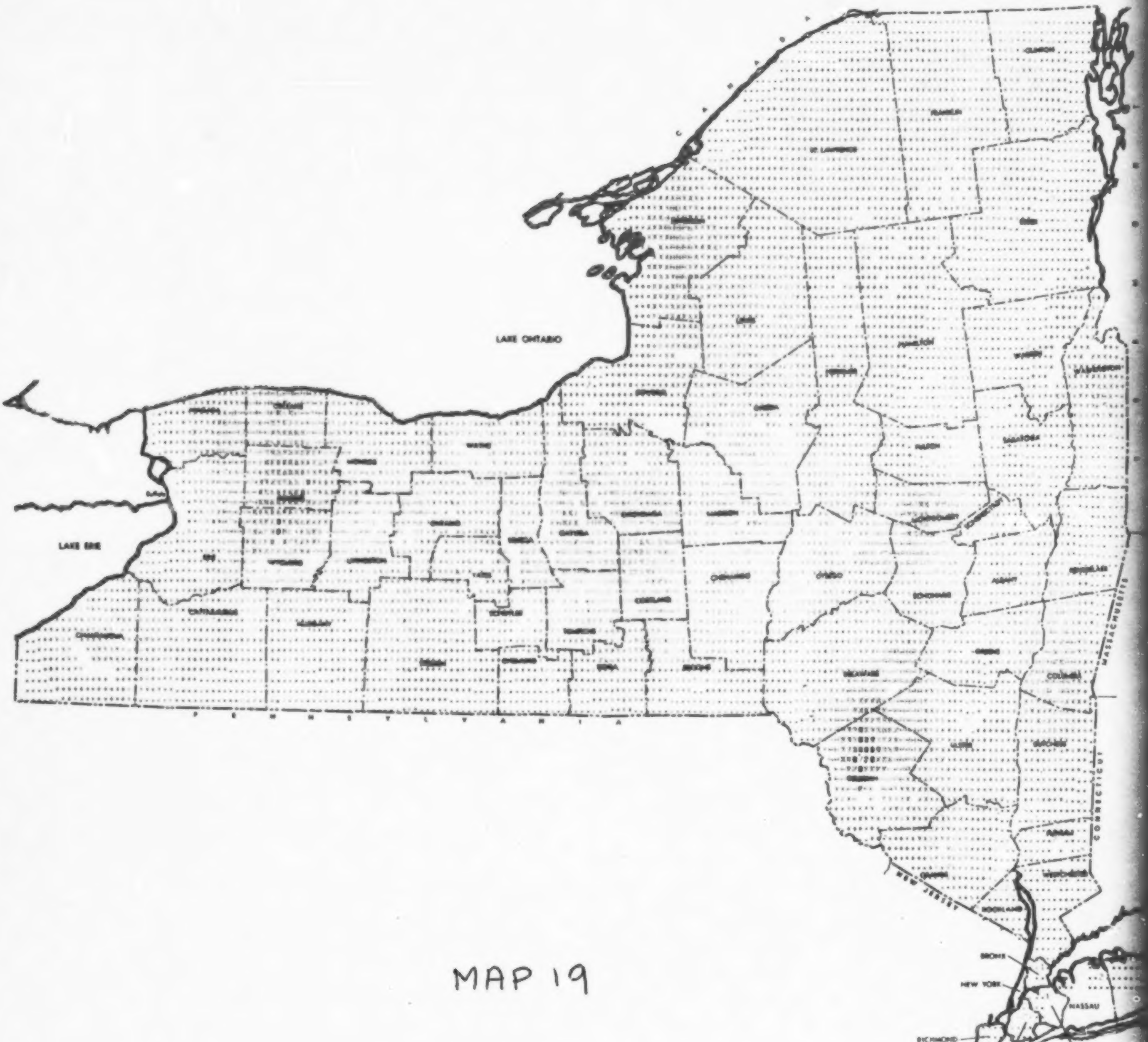
LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1		65	0.0 — 0.1
2	░	13	0.1 — 203.4
3	░	14	203.5 — 406.8
4	░	20	406.9 — 610.2
5	░	15	610.3 — 813.6
6	▒	6	813.7 — 1017.0
7	▓	1	1017.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

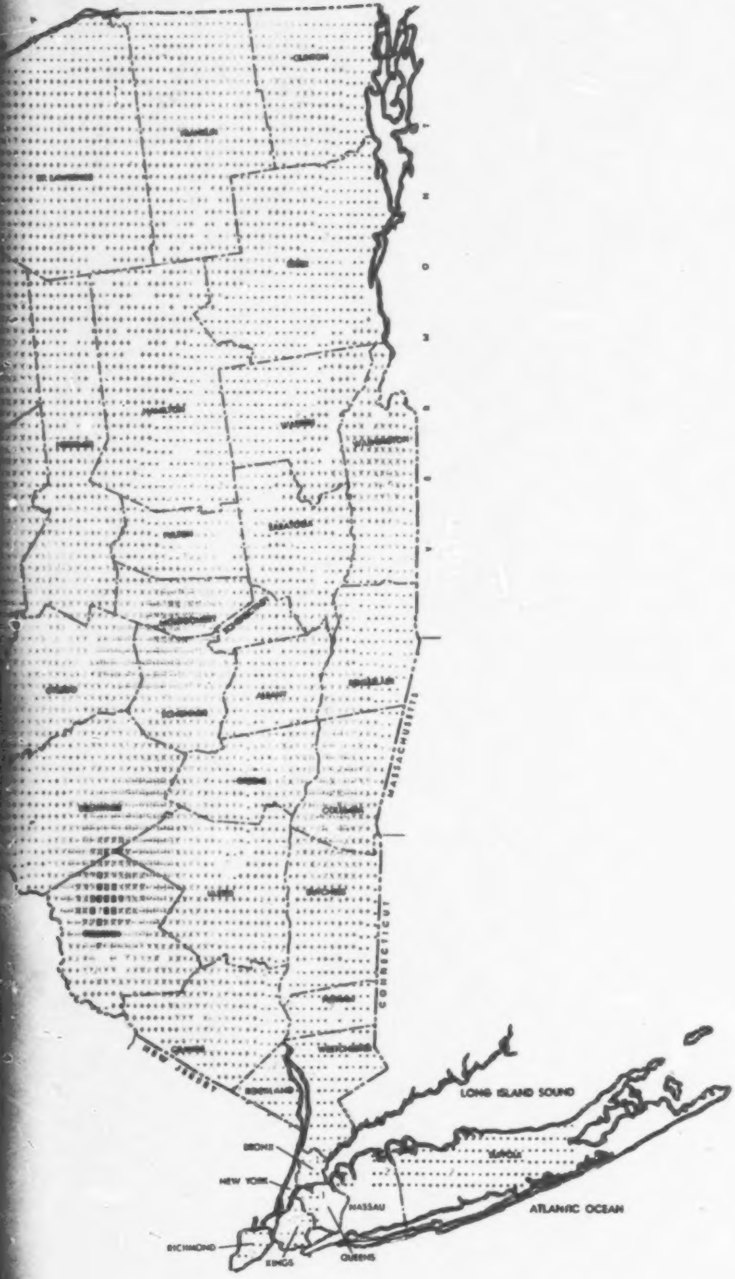
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
MASSACHUSETTS
CONNECTICUT
BRONX
NEW YORK
NASSAU
RICHMOND
KINGS
QUEENS

MAP 19

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NASSAU
SUFFOLK
ROCKLAND
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 19

NEW YORK STATE DEPARTMENT OF HEALTH

AGRICULTURAL WASTE DENSITY 1985

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

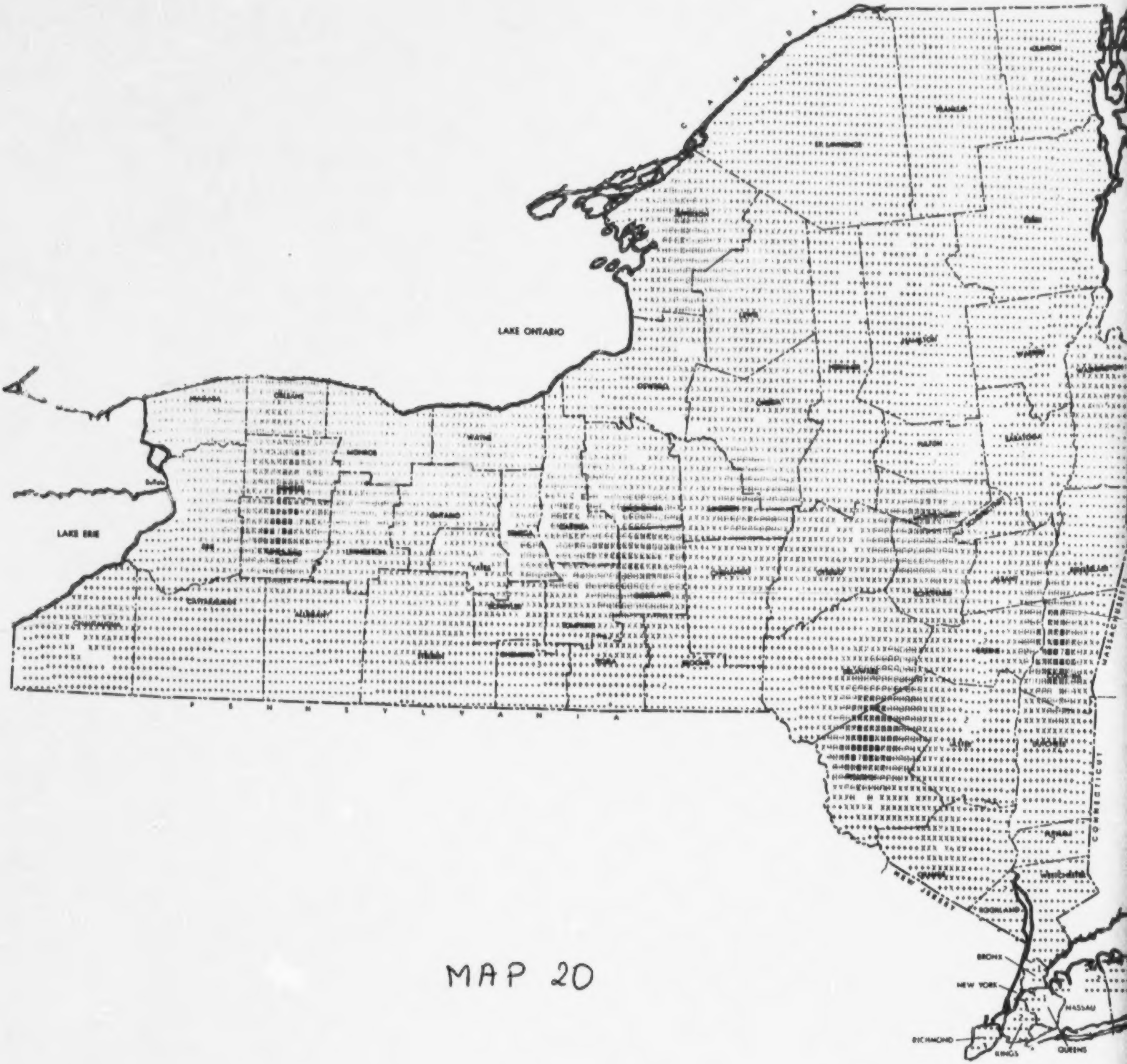
LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	·	65	0.0 — 0.1
2	░	14	0.1 — 203.4
3	░	18	203.5 — 406.8
4	░	23	406.9 — 610.2
5	▒	5	610.3 — 813.6
6	▦	5	813.7 — 1017.0
7	■	4	1017.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

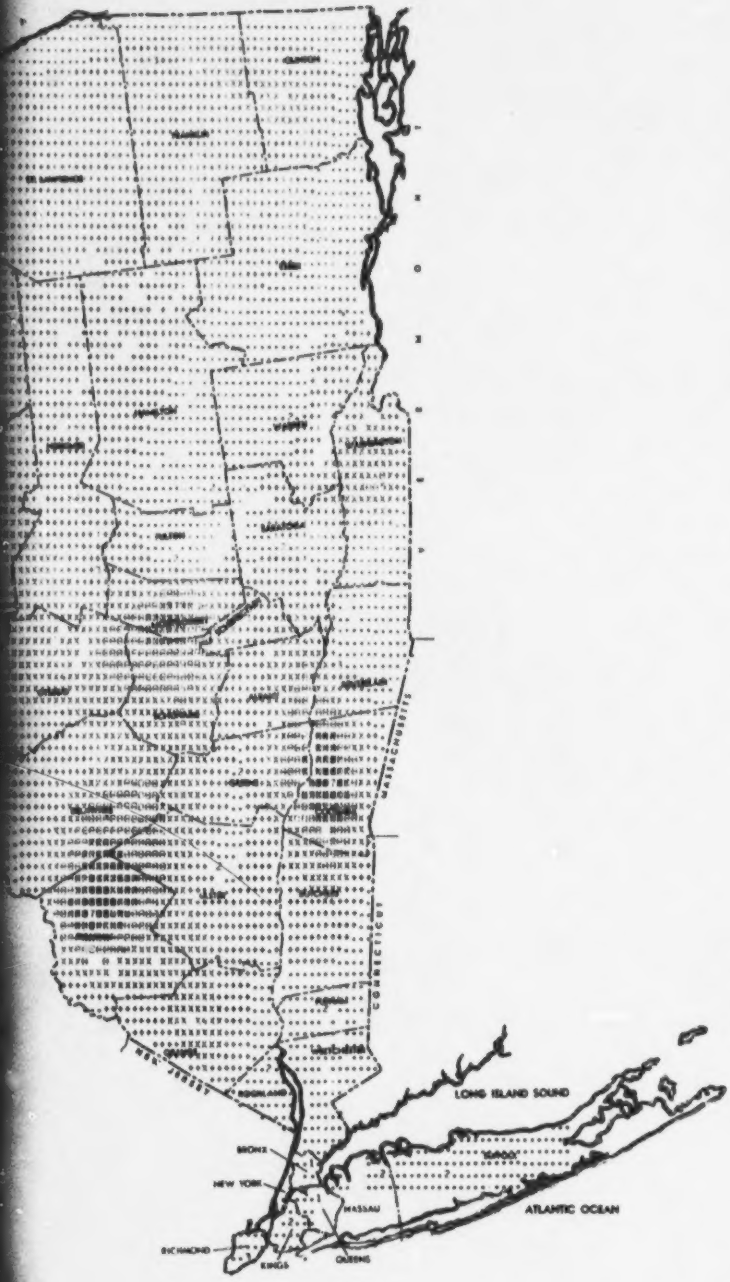
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


C A N A D A
LAKE ONTARIO
LAKE ERIE
P E N N S Y L V A N I A
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NASSAU

MAP 20

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NASSAU
SUFFOLK
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 20

NEW YORK STATE DEPARTMENT OF HEALTH

AGRICULTURAL WASTE DENSITY 1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

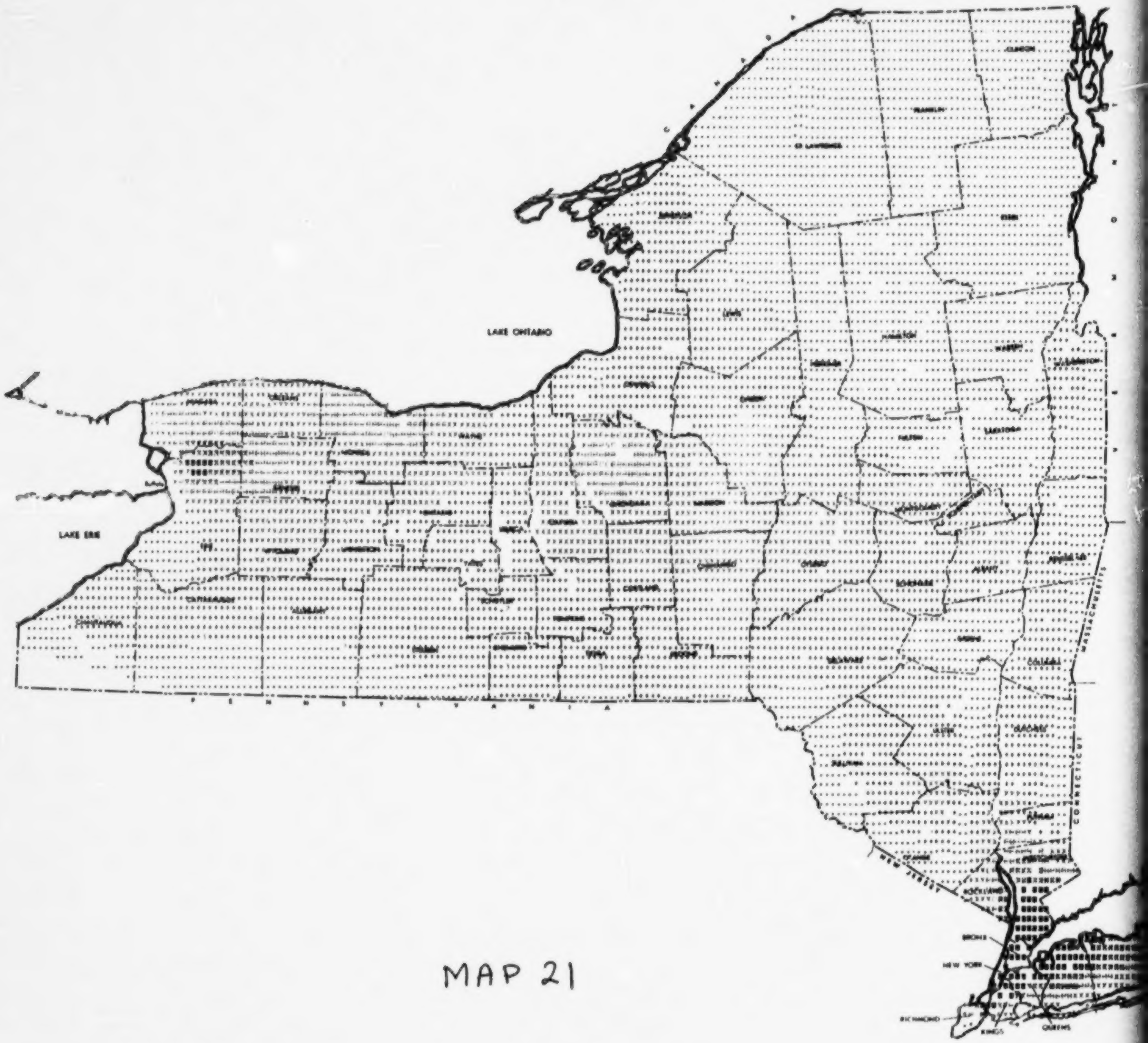
LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1		65	0.0 — 0.1
2	⁚	17	0.1 — 203.4
3	⁘	15	203.5 — 406.8
4	░	22	406.9 — 610.2
5	▒	5	610.3 — 813.6
6	▓	5	813.7 — 1017.0
7	█	5	1017.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

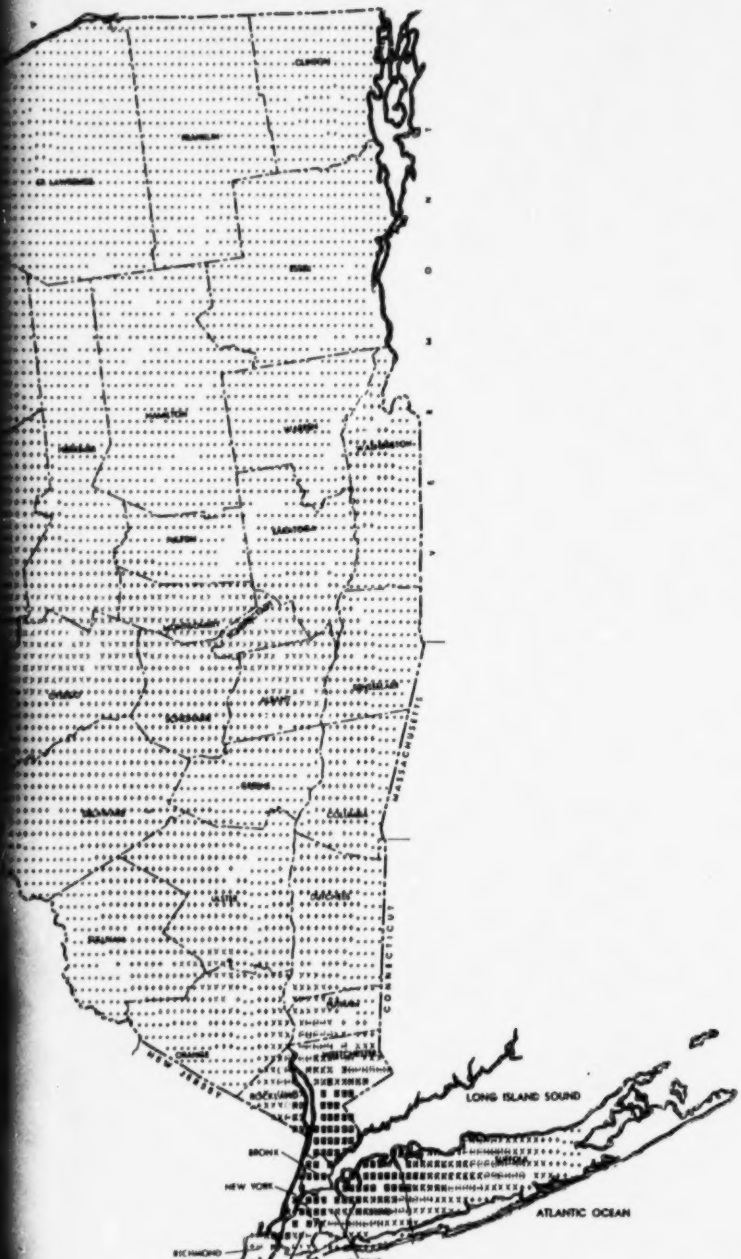
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
CLINTON
FRANKLIN
ST LAWRENCE
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 21

A


CONNECTICUT
MASSACHUSETTS
NEW JERSEY
ORANGE
ROCKLAND
SULLIVAN
SUFFOLK
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 21

NEW YORK STATE DEPARTMENT OF HEALTH

TOTAL WASTE DENSITY
1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1		67	0.0 — 0.1
2	⋯	11	0.1 — 400.0
3	░	31	400.1 — 800.0
4	░	18	800.1 — 1200.0
5	▤	4	1200.1 — 1600.0
6	▒	1	1600.1 — 2000.0
7	▦	8	2000.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

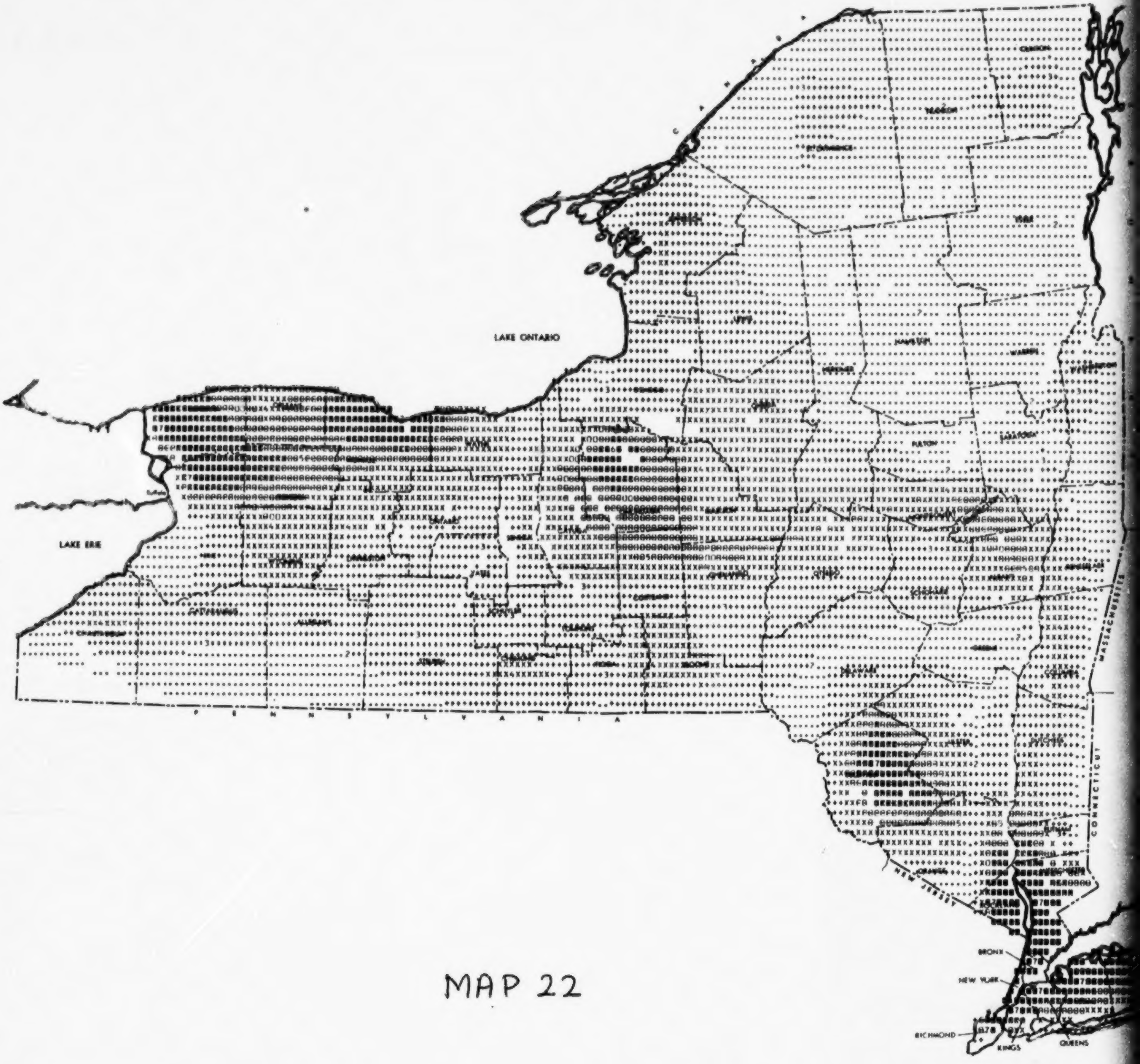
N

SCALE IN MILES

10 0 10 20 30 40 50 60 70

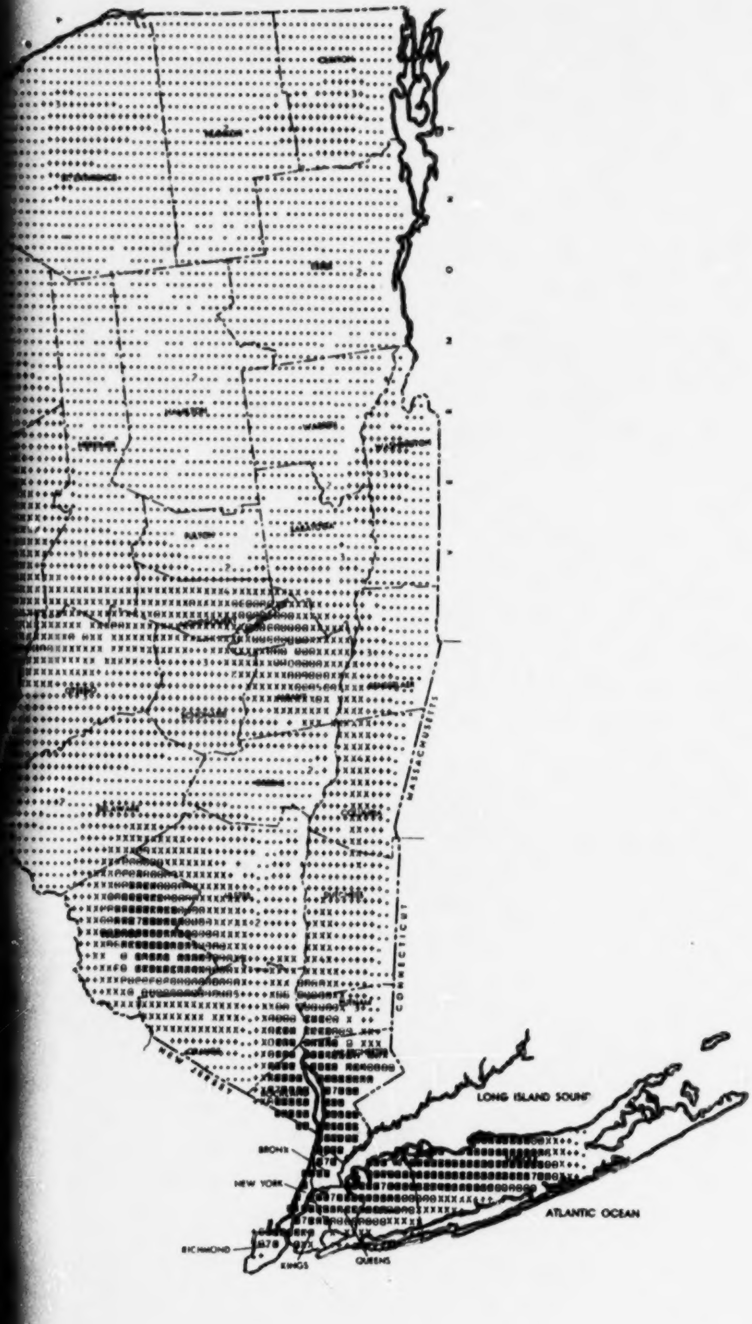
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
P E N N S Y L V A N I A
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS

MAP 22

A


LONG ISLAND SOUND
ATLANTIC OCEAN
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

MAP 22

NEW YORK STATE DEPARTMENT OF HEALTH

TOTAL WASTE DENSITY
1985

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1	'	67	0.0 — 0.1
2	⋯	9	0.1 — 400.0
3	∷	23	400.1 — 800.0
4	×	18	800.1 — 1200.0
5	⊟	9	1200.1 — 1600.0
6	▦	1	1600.1 — 2000.0
7	■	13	2000.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

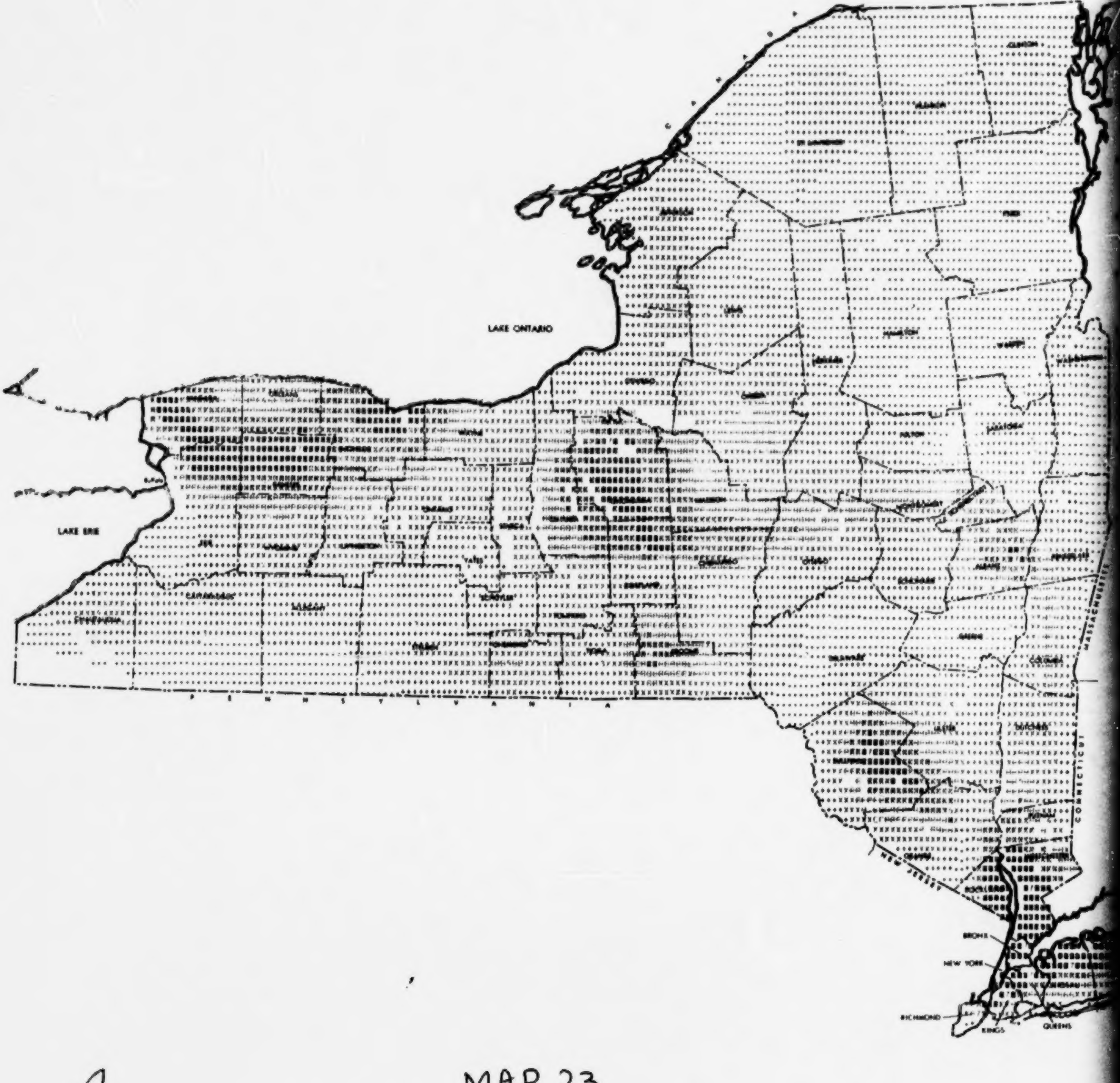
N

SCALE IN MILES

10 0 10 20 30 40 50 60 70

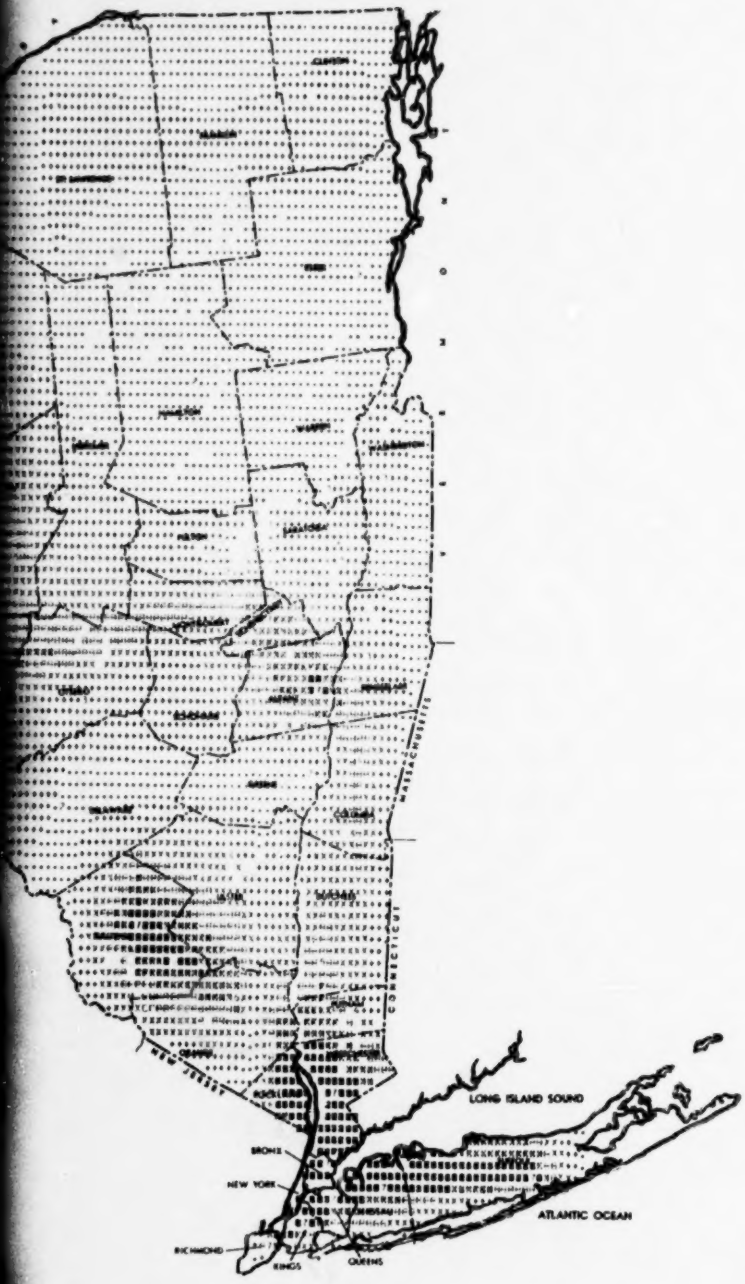
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
ORLEANS
WAYNE
ONTARIO
SENECA
YATES
ERIE
CATTARAUGUS
ALLEGANY
SCHUYLER
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
ORANGE
PUTNAM
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS

A

MAP 23


CLINTON
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 23

NEW YORK STATE DEPARTMENT OF HEALTH

TOTAL WASTE DENSITY

1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1		67	0.0 — 0.1
2	░	6	0.1 — 400.0
3	░	23	400.1 — 800.0
4	░	10	800.1 — 1200.0
5	░	11	1200.1 — 1600.0
6	▒	5	1600.1 — 2000.0
7	▓	18	2000.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

N

SCALE IN MILES
10 0 10 20 30 40 50 60 70

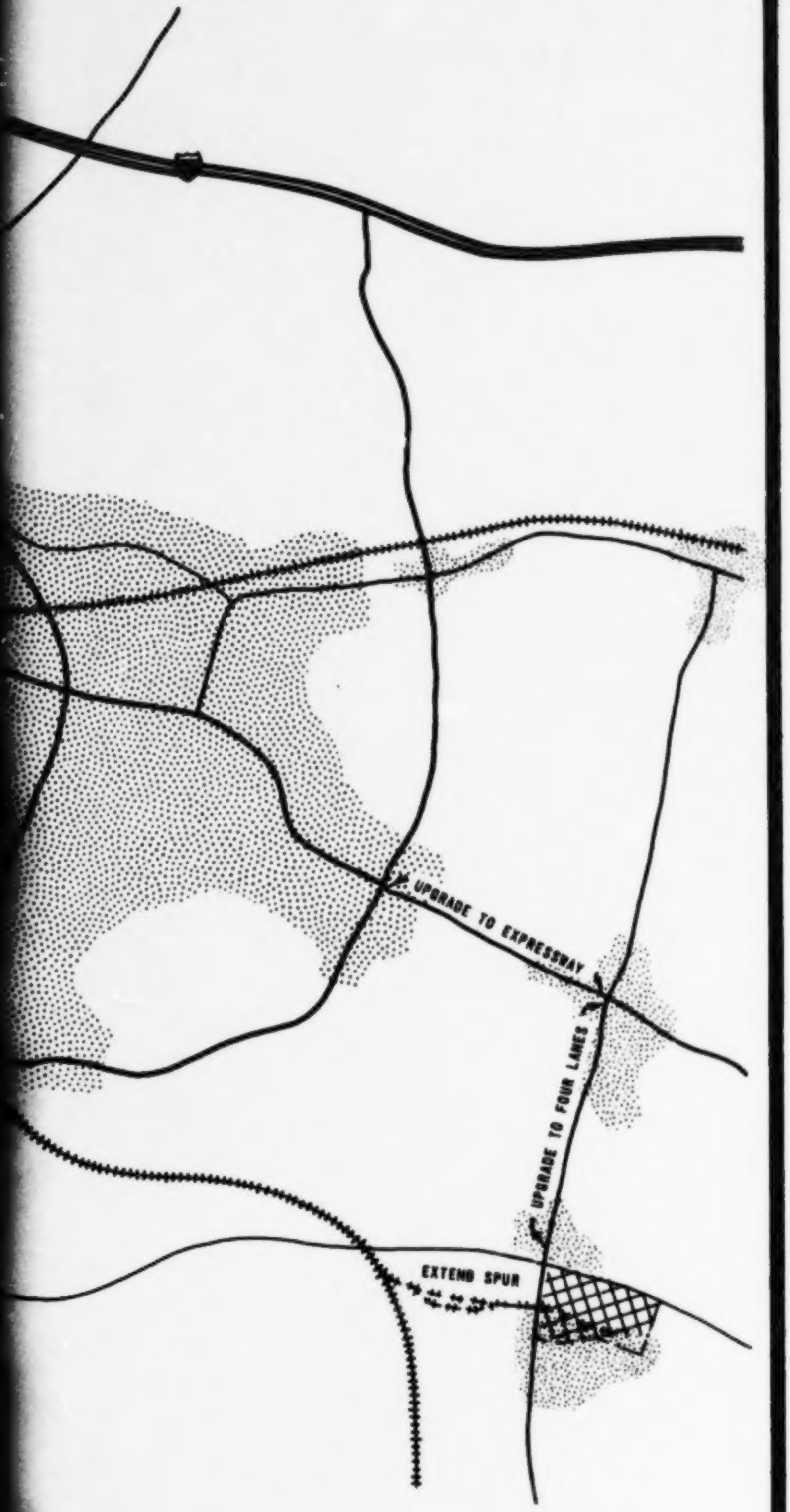
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B

MAP 24

A

MAP 24


UPGRADE TO EXPRESSWAY
UPGRADE TO FOUR LANES
EXTEND SPUR

NEW YORK STATE DEPARTMENT OF HEALTH

REGIONAL DEVELOPMENT AND SITE LOCATION

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

TRANSPORTATION

HIGHWAYS

═ INTERSTATE

━ EXPRESSWAY

— STATE PRIMARY

─ STATE SECONDARY

┼┼┼ RAIL

DEVELOPMENT

▨ URBAN CENTER

▒ SUBURBAN

░ RURAL CLUSTER

▦ LANDFILL SITE

SOURCE: CONSULTANT'S ANALYSIS

B

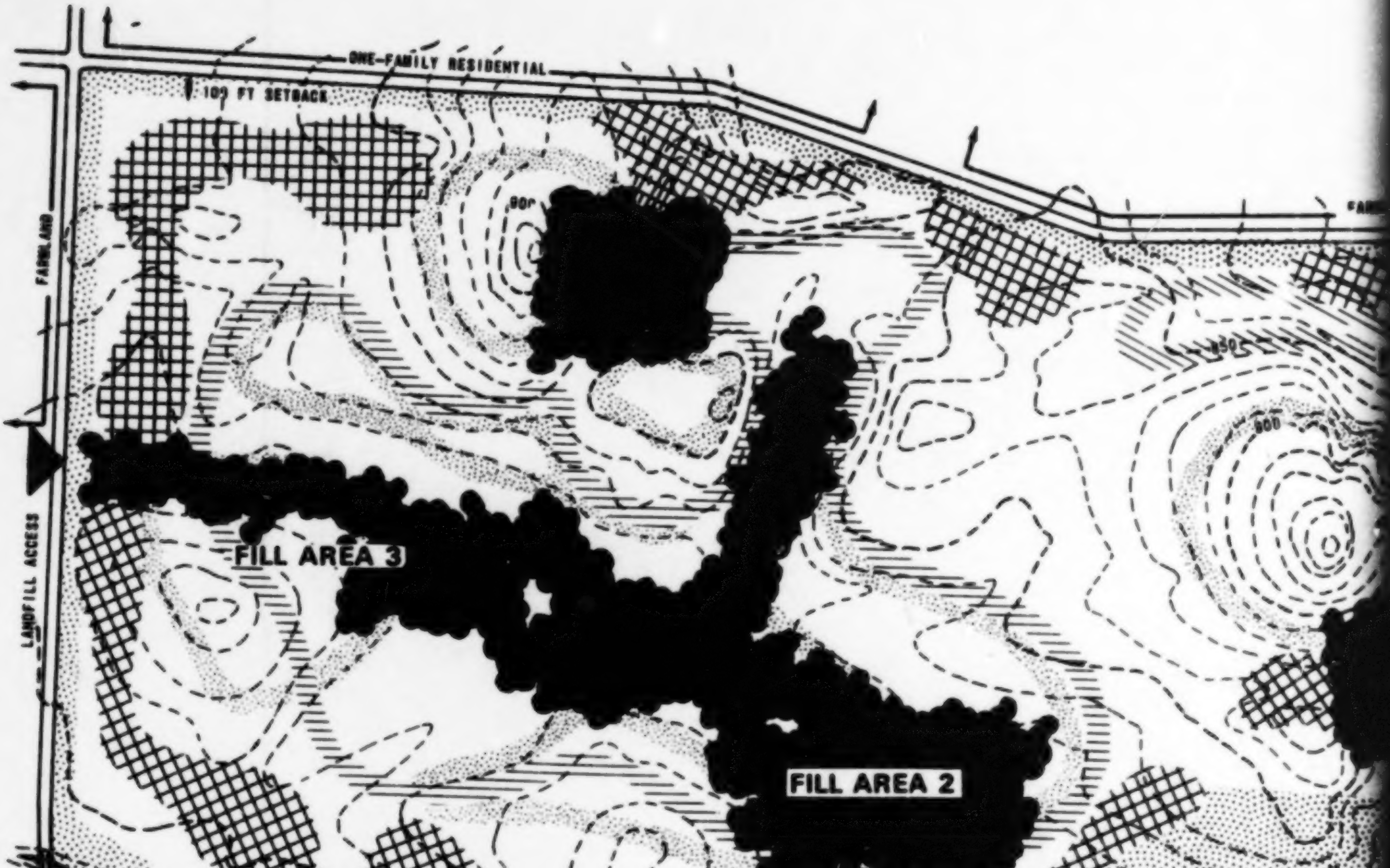
DATE: OCTOBER, 1969

N

SCALE IN MILES

3 2 1 0 3 6 9

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965


ONE-FAMILY RESIDENTIAL
100 FT SETBACK
FARMLAND
FARM
LANDFILL ACCESS
900
850
FILL AREA 3
FILL AREA 2
800
500 FT SETBACK
200 FT SETBACK
ONE-FAMILY RESIDENTIAL
ONE-FAMILY RESIDENTIAL
UNDISTURBED FOR RECREATION AREA
ONE-FAMILY RESIDENTIAL

NOTE: FILL AREA #1 - 1970

FILL AREA #2 - 1975

FILL AREA #3 - 1985

MAP 25

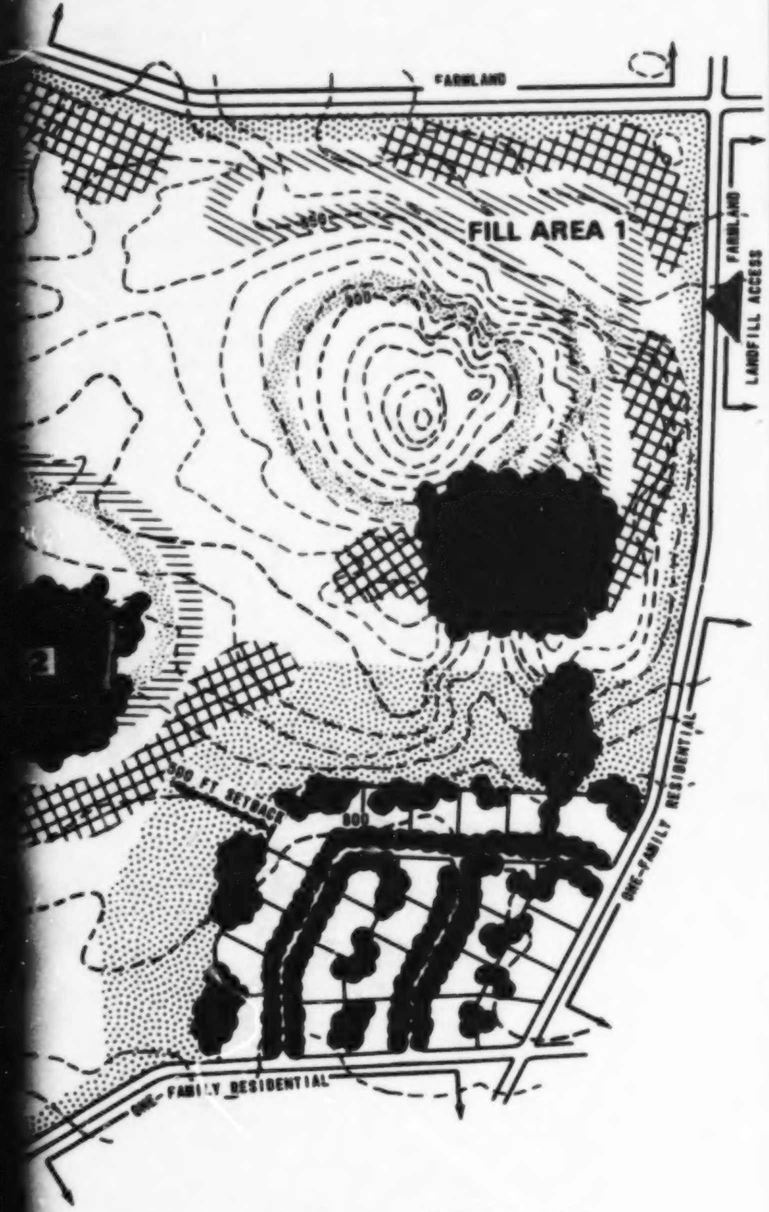
A

MAP 25

NEW YORK STATE DEPARTMENT OF HEALTH

PROPOSED LANDFILL OPERATION 1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY


FARMLAND
FILL AREA 1
FARMLAND
LANDFILL ACCESS
800
800
2
500 FT SETBACK
800
ONE-FAMILY RESIDENTIAL
ONE-FAMILY RESIDENTIAL

NOTE: FILL AREA #1 - 1970 TO 1975

FILL AREA #2 - 1975 TO 1985

FILL AREA #3 - 1985 TO 1995

LEGEND

░ SETBACK AREA

▨ LANDFILL AREA

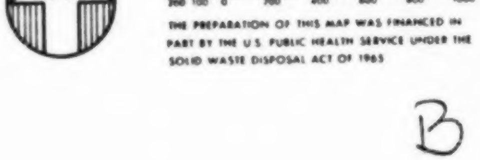
▒ BORROW AREA

▦ BUFFER SCREEN

☐ UNDISTURBED

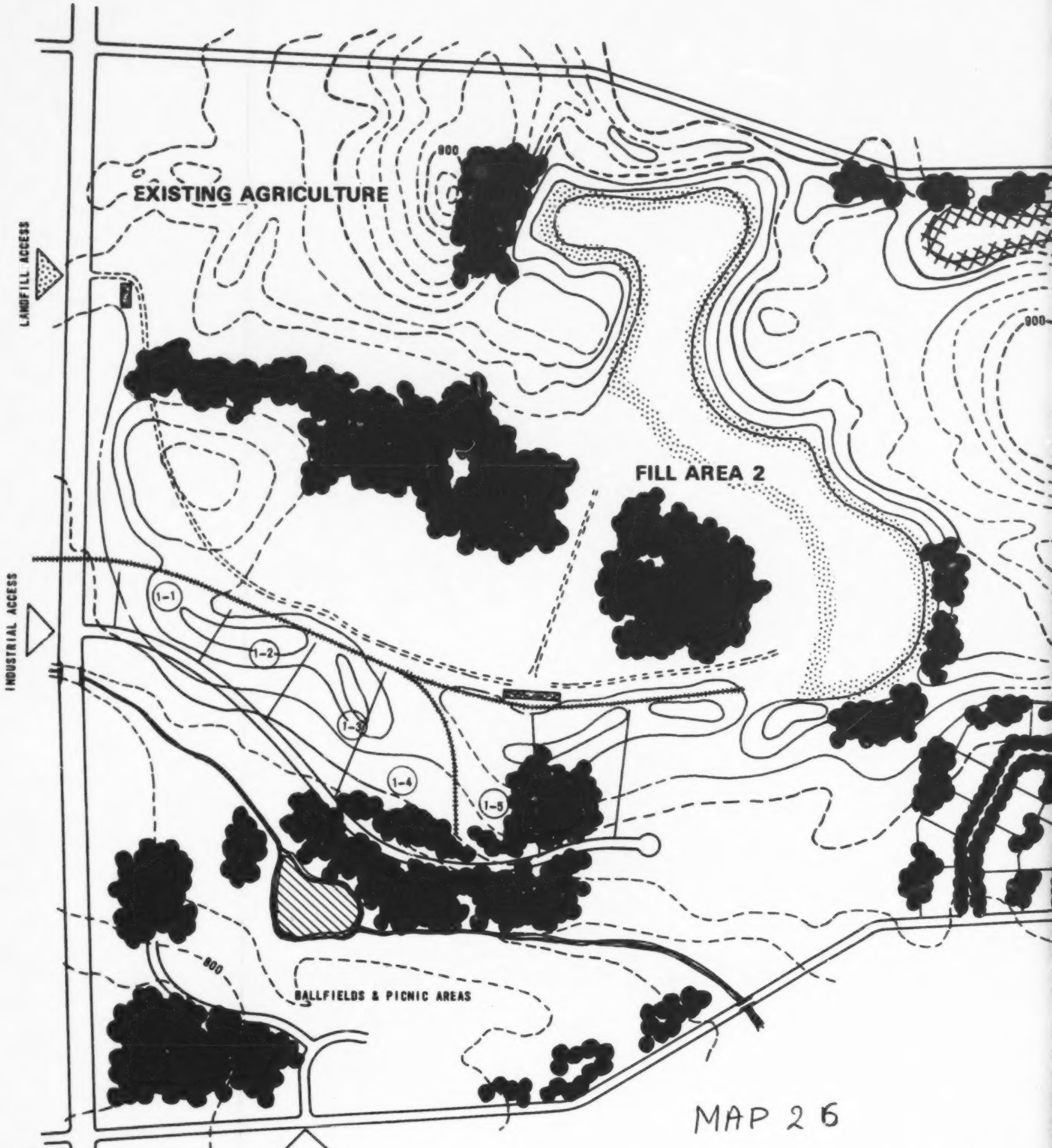
SOURCE: CONSULTANT'S ANALYSIS

DATE: OCTOBER, 1969


N
SCALE IN FEET
200 100 0 200 400 600 800 1000

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

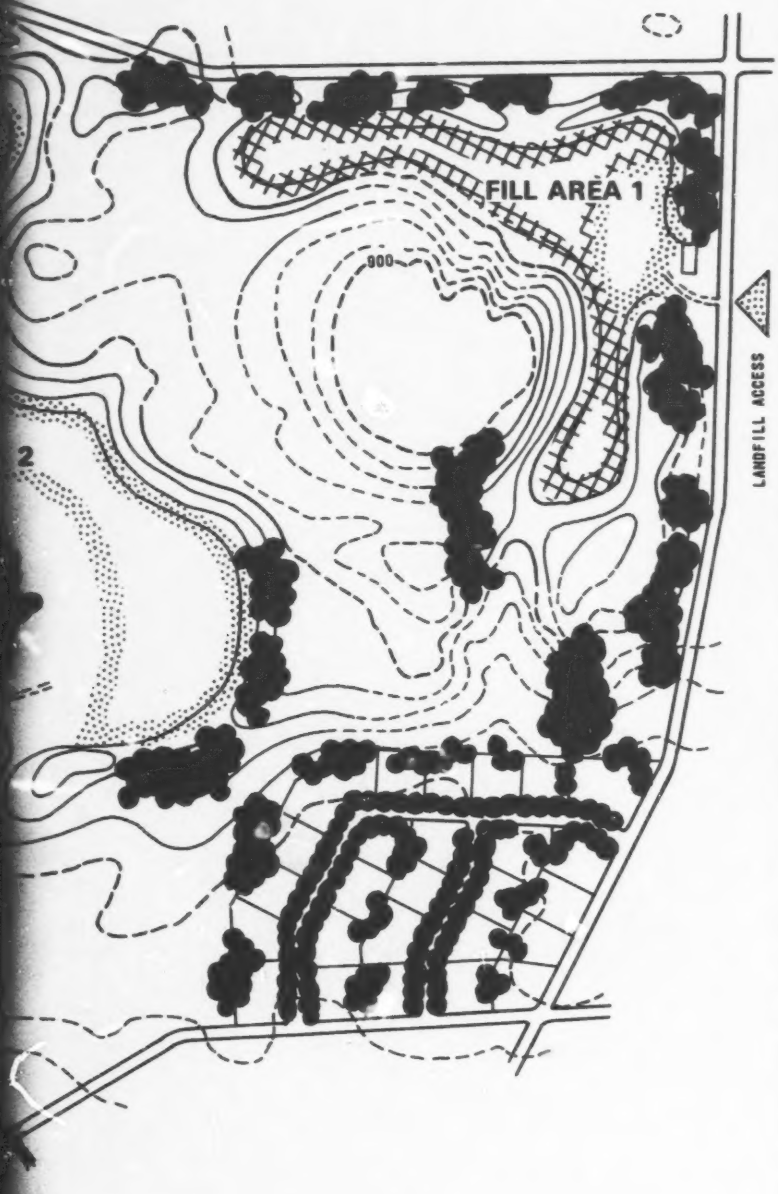
B


800
EXISTING AGRICULTURE
LANDFILL ACCESS
900
FILL AREA 2
INDUSTRIAL ACCESS
1-1
1-2
1-3
1-4
1-5
800
BALLFIELDS & PICNIC AREAS
RECREATION ACCESS

MAP 26

A

MAP 26



NEW YORK STATE DEPARTMENT OF HEALTH

PROPOSED DEVELOPMENT
1975

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

- ▦ COMPLETED FILL AREA
- ░ ACTIVE FILL AREA
- ▒ CONTROL AND OPERATION FACILITIES
- ■ LANDSCAPED AREAS
- ▧ WATER RESOURCES
- ═ ROADS AND PARKING
- ┼┼┼ RAILROAD SPUR

SOURCE: CONSULTANT'S ANALYSIS

DATE: OCTOBER, 1969

N

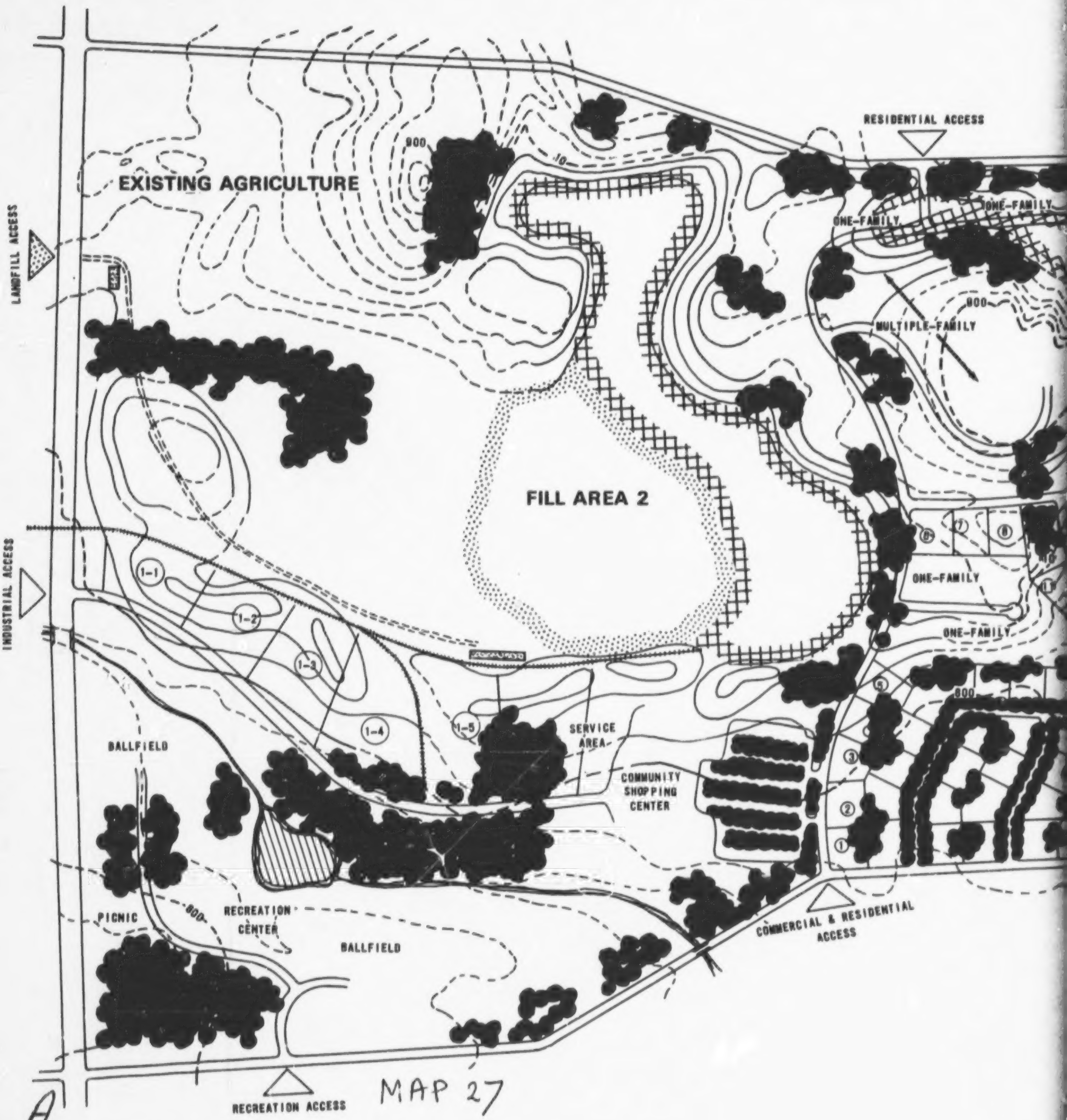
SCALE IN FEET

200 100 0 200 400 600 800 1000

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

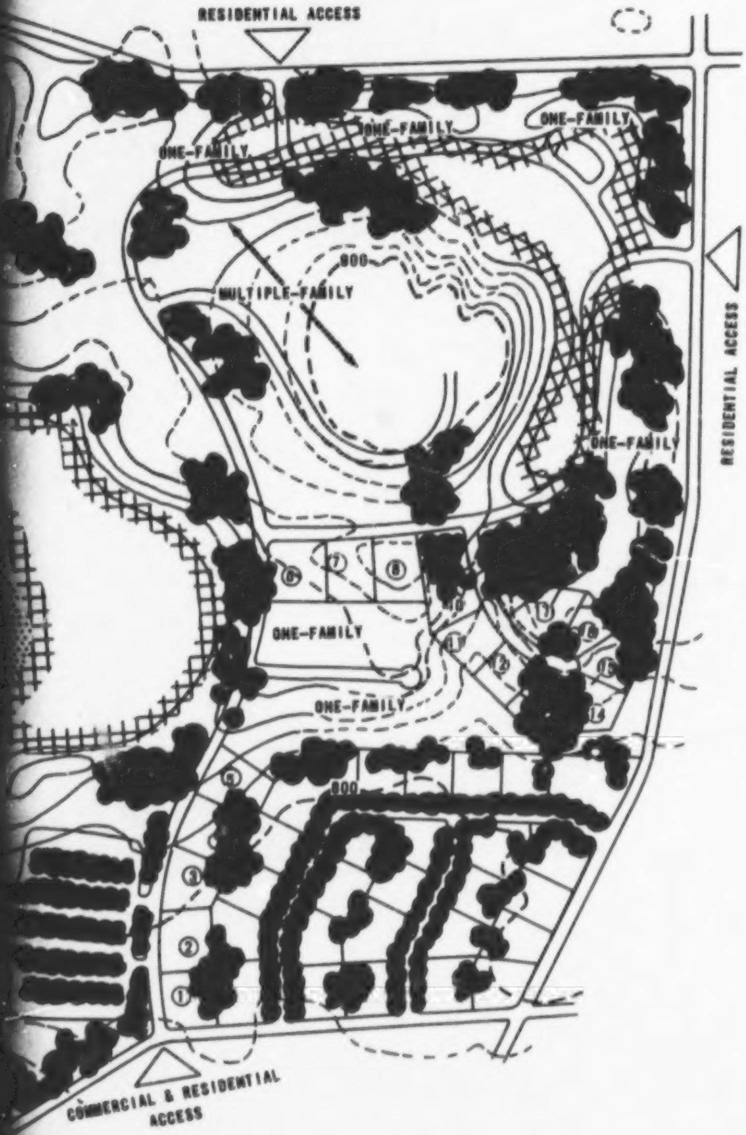
26

B


RESIDENTIAL ACCESS
900
10
EXISTING AGRICULTURE
LANDFILL ACCESS
ONE-FAMILY
ONE-FAMILY
900
MULTIPLE-FAMILY
FILL AREA 2
INDUSTRIAL ACCESS
6
7
8
ONE-FAMILY
ONE-FAMILY
1-1
1-2
1-3
1-4
1-5
5
800
SERVICE AREA
COMMUNITY SHOPPING CENTER
3
2
1
BALLFIELD
PICNIC
800
RECREATION CENTER
BALLFIELD
COMMERCIAL & RESIDENTIAL ACCESS
RECREATION ACCESS

MAP 27

A


RESIDENTIAL ACCESS
ONE-FAMILY
ONE-FAMILY
ONE-FAMILY
800
MULTIPLE-FAMILY
RESIDENTIAL ACCESS
ONE-FAMILY
ONE-FAMILY
ONE-FAMILY
800
1
2
3
5
6
7
8
10
11
12
13
14
15
16
COMMERCIAL & RESIDENTIAL ACCESS

MAP 27

NEW YORK STATE DEPARTMENT OF HEALTH

PROPOSED DEVELOPMENT 1980

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

▦ COMPLETED FILL AREA

░ ACTIVE FILL AREA

▒ CONTROL AND OPERATION FACILITIES

■ LANDSCAPED AREAS

▨ WATER RESOURCES

═ ROADS AND PARKING

┼┼┼ RAILROAD SPUR

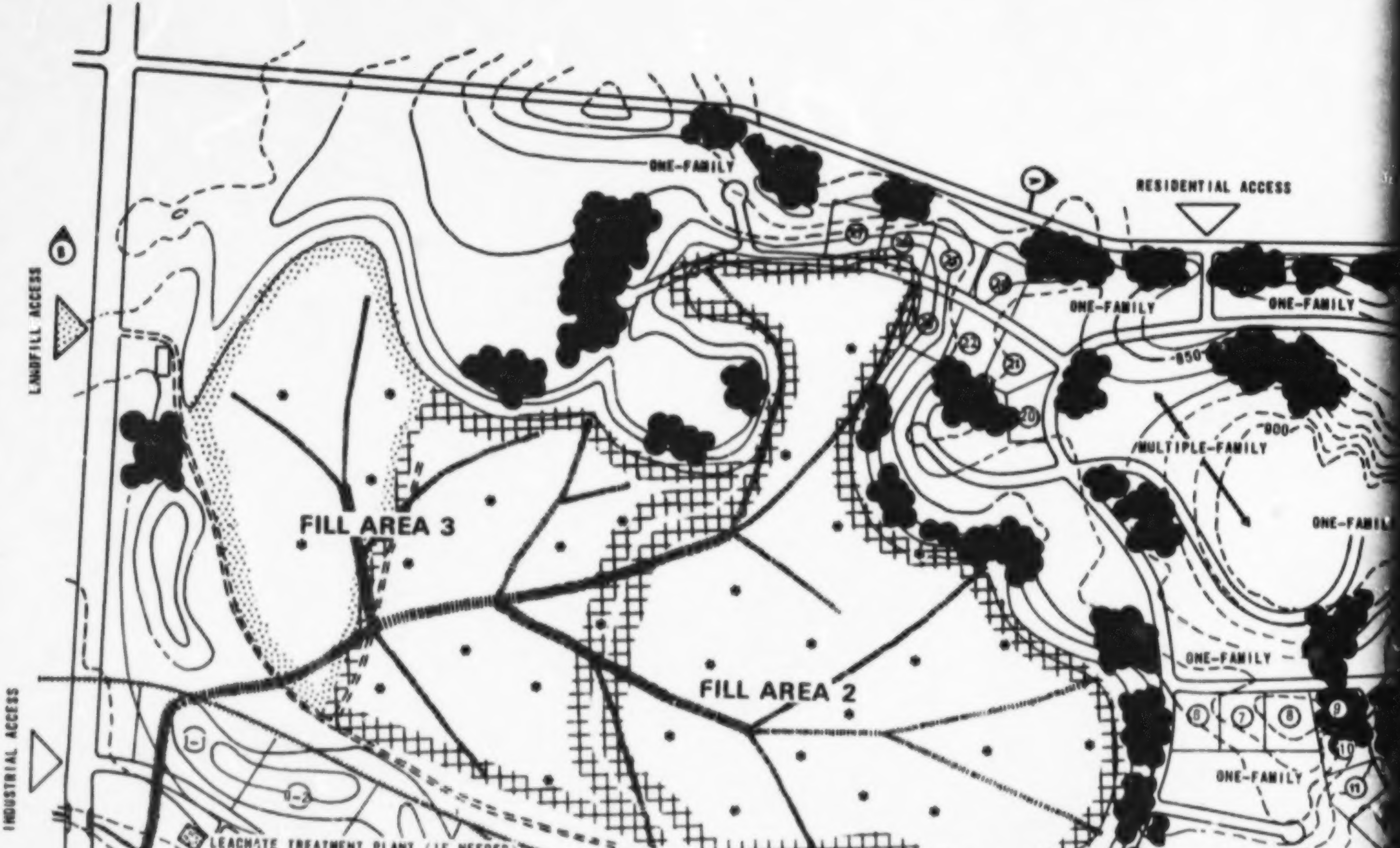
SOURCE: CONSULTANT'S ANALYSIS

DATE: OCTOBER, 1969

SCALE IN FEET

200 100 0 200 400 600 800 1000

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965


LANDFILL ACCESS
INDUSTRIAL ACCESS
ONE-FAMILY
RESIDENTIAL ACCESS
ONE-FAMILY
ONE-FAMILY
850
900
MULTIPLE-FAMILY
ONE-FAMILY
FILL AREA 3
FILL AREA 2
ONE-FAMILY
ONE-FAMILY
ONE-FAMILY
LEACHATE TREATMENT PLANT (IF NEEDED)
BALLFIELD
SERVICE AREA
COMMUNITY SHOPPING CENTER
800
PICNIC
800
RECREATION CENTER
BALLFIELD
SWIMMING POOL
COMMERCIAL & RESIDENTIAL ACCESS
RECREATION ACCESS

MAP 28

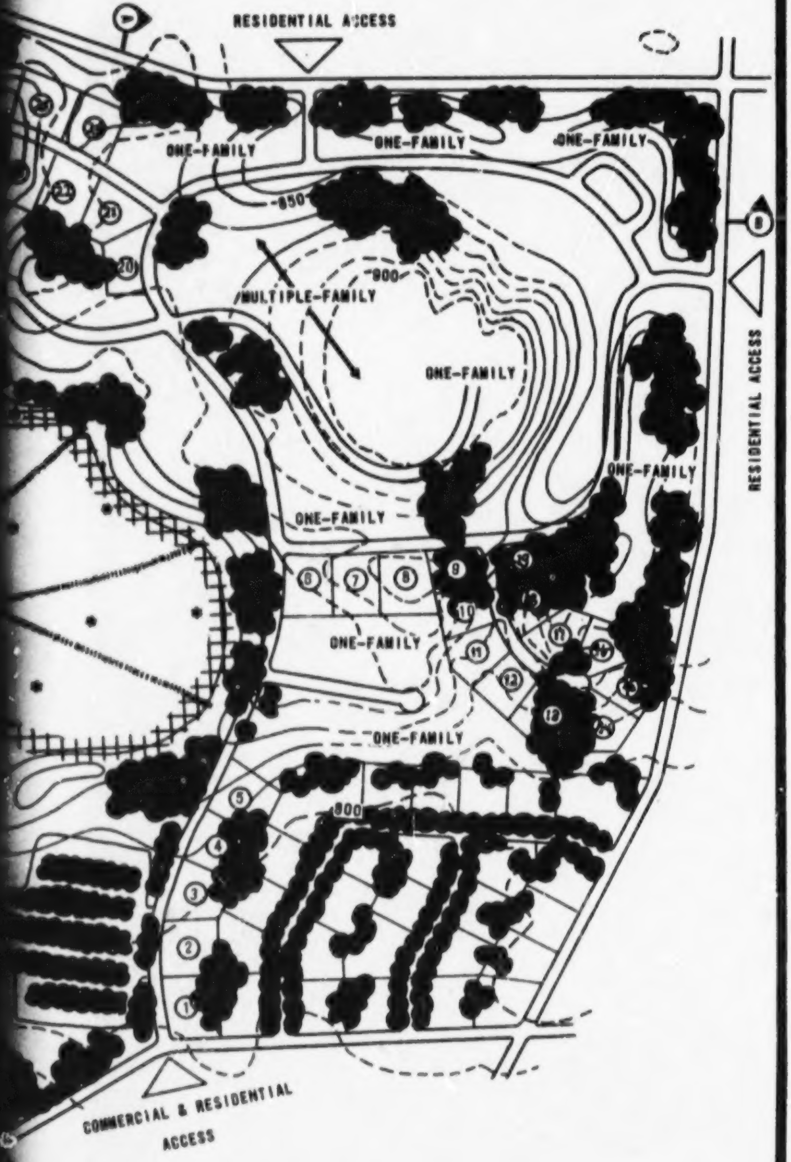
A

MAP 28

NEW YORK STATE DEPARTMENT OF HEALTH

PROPOSED DEVELOPMENT
1990

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY


RESIDENTIAL ACCESS
ONE-FAMILY
ONE-FAMILY
ONE-FAMILY
850
900
MULTIPLE-FAMILY
ONE-FAMILY
RESIDENTIAL ACCESS
ONE-FAMILY
ONE-FAMILY
ONE-FAMILY
ONE-FAMILY
800
COMMERCIAL & RESIDENTIAL ACCESS

LEGEND

- ▦ COMPLETED FILL AREA
- ░ ACTIVE FILL AREA
- ▒ CONTROL AND OPERATION FACILITIES
- ■ LANDSCAPED AREAS
- ▨ WATER RESOURCES
- ═ ROADS AND PARKING
- ┼┼┼ RAILROAD SPUR
- ||||| SURFACE DRAINAGE
- ● METHANE ESCAPE

B

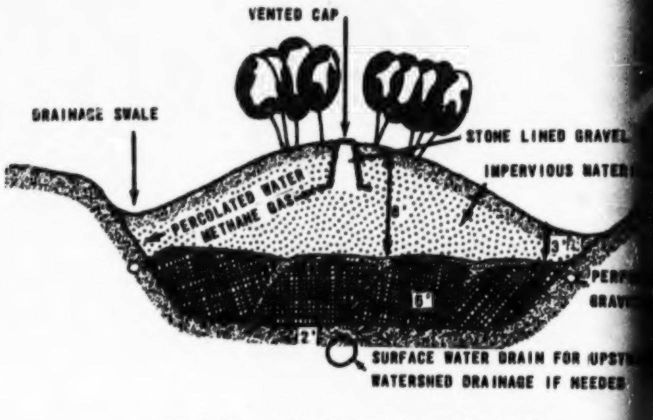
SOURCE: CONSULTANT'S ANALYSIS

DATE: OCTOBER, 1969

SCALE IN FEET

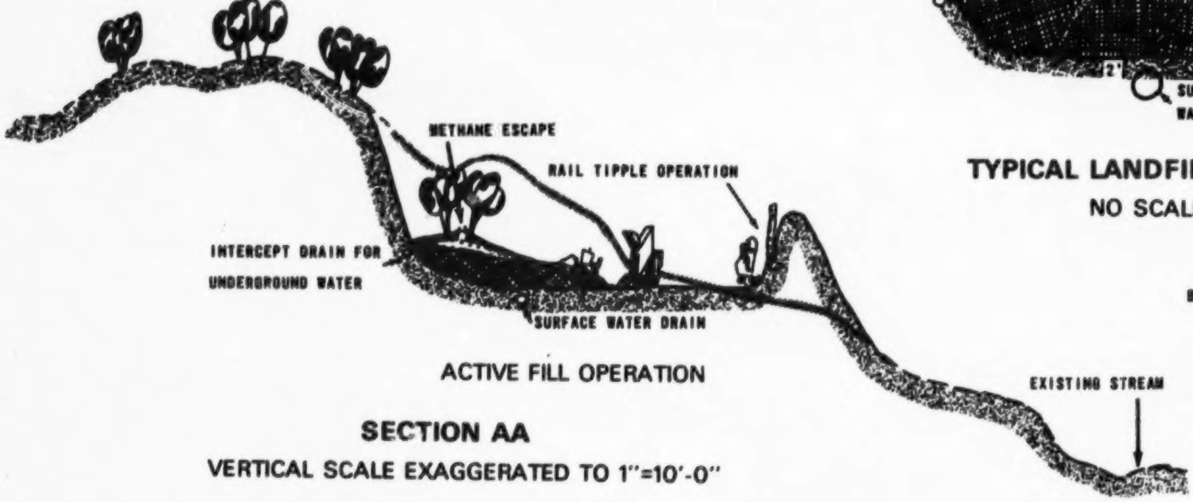
200 100 0 200 400 600 800 1000

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965


VENTED CAP
DRAINAGE SWALE
STONE LINED GRAVEL
IMPERVIOUS MATER
PERCOLATED WATER
METHANE GAS
3'
6'
2'
PERF
GRAV
SURFACE WATER DRAIN FOR UPST
WATERSHED DRAINAGE IF NEEDED

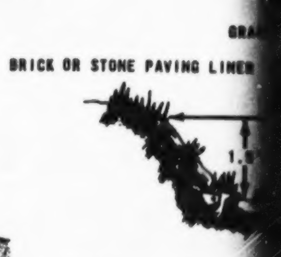
TYPICAL LANDFILL SECTION

NO SCALE


METHANE ESCAPE
RAIL TIPPLE OPERATION
INTERCEPT DRAIN FOR
UNDERGROUND WATER
SURFACE WATER DRAIN
ACTIVE FILL OPERATION
EXISTING STREAM

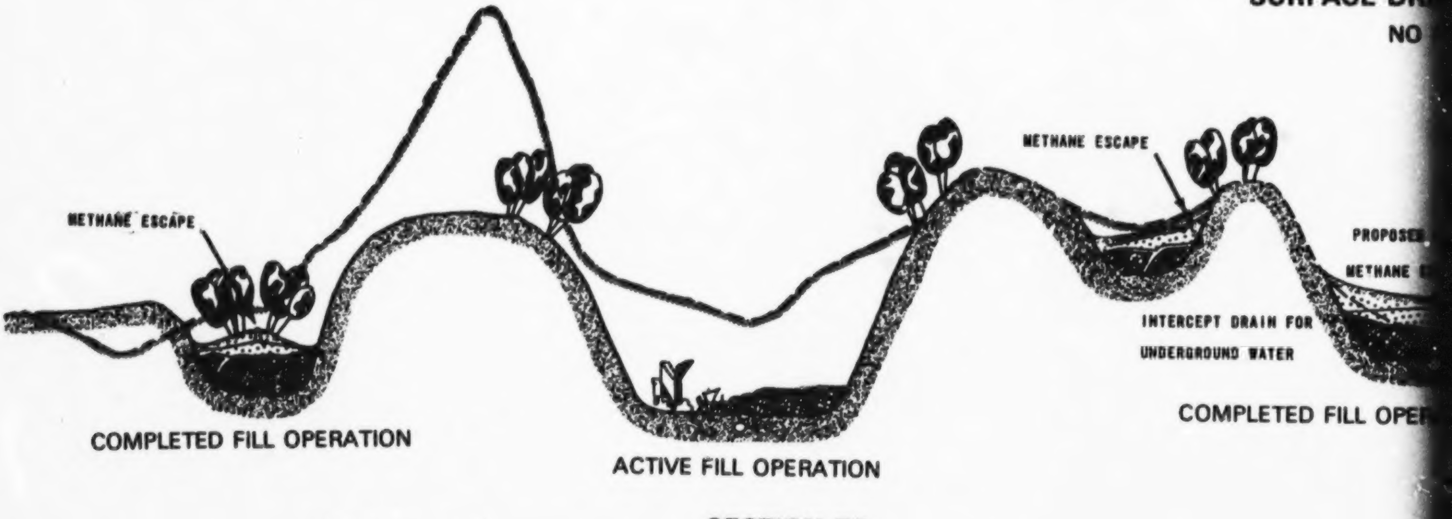
SECTION AA

VERTICAL SCALE EXAGGERATED TO 1"=10'-0"


GRA
BRICK OR STONE PAVING LINER
1.0

SURFACE DR

NO


METHANE ESCAPE
METHANE ESCAPE
PROPOSE
METHANE E
INTERCEPT DRAIN FOR
UNDERGROUND WATER
COMPLETED FILL OPERATION
ACTIVE FILL OPERATION
COMPLETED FILL OPER

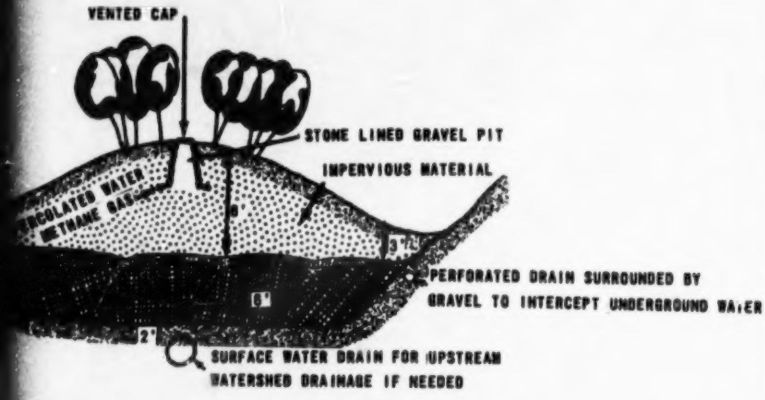
MAP 29

SECTION BB

VERTICAL SCALE EXAGGERATED TO 1"=10'-0"

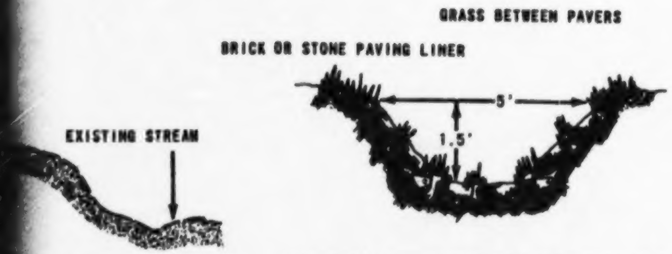
A

MAP 29


VENTED CAP
STONE LINED GRAVEL PIT
IMPERVIOUS MATERIAL
PERCOLATED WATER
METHANE GAS
6"
5'
6"
2'
PERFORATED DRAIN SURROUNDED BY GRAVEL TO INTERCEPT UNDERGROUND WATER
SURFACE WATER DRAIN FOR UPSTREAM WATERSHED DRAINAGE IF NEEDED

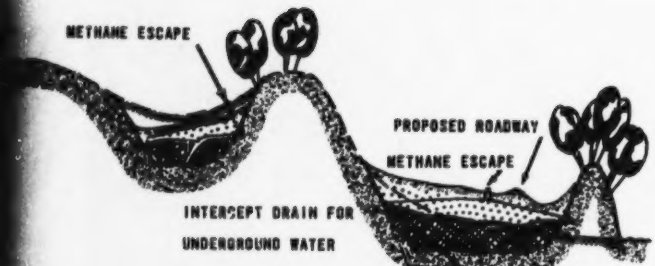
YPICAL LANDFILL SECTION

NO SCALE


GRASS BETWEEN PAVERS
BRICK OR STONE PAVING LINER
5'
1.5'
EXISTING STREAM

SURFACE DRAINAGE DETAIL

NO SCALE


METHANE ESCAPE
PROPOSED ROADWAY
METHANE ESCAPE
INTERCEPT DRAIN FOR UNDERGROUND WATER

COMPLETED FILL OPERATION

10'-0"

NEW YORK STATE DEPARTMENT OF HEALTH

TYPICAL SITE SECTIONS

STATEWIDE COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

LEGEND

■	EXISTING GRADE
▩	PROPOSED GRADES
░	EARTH FILL
▨	REFUSE CELLS

SOURCE: CONSULTANT'S ANALYSIS

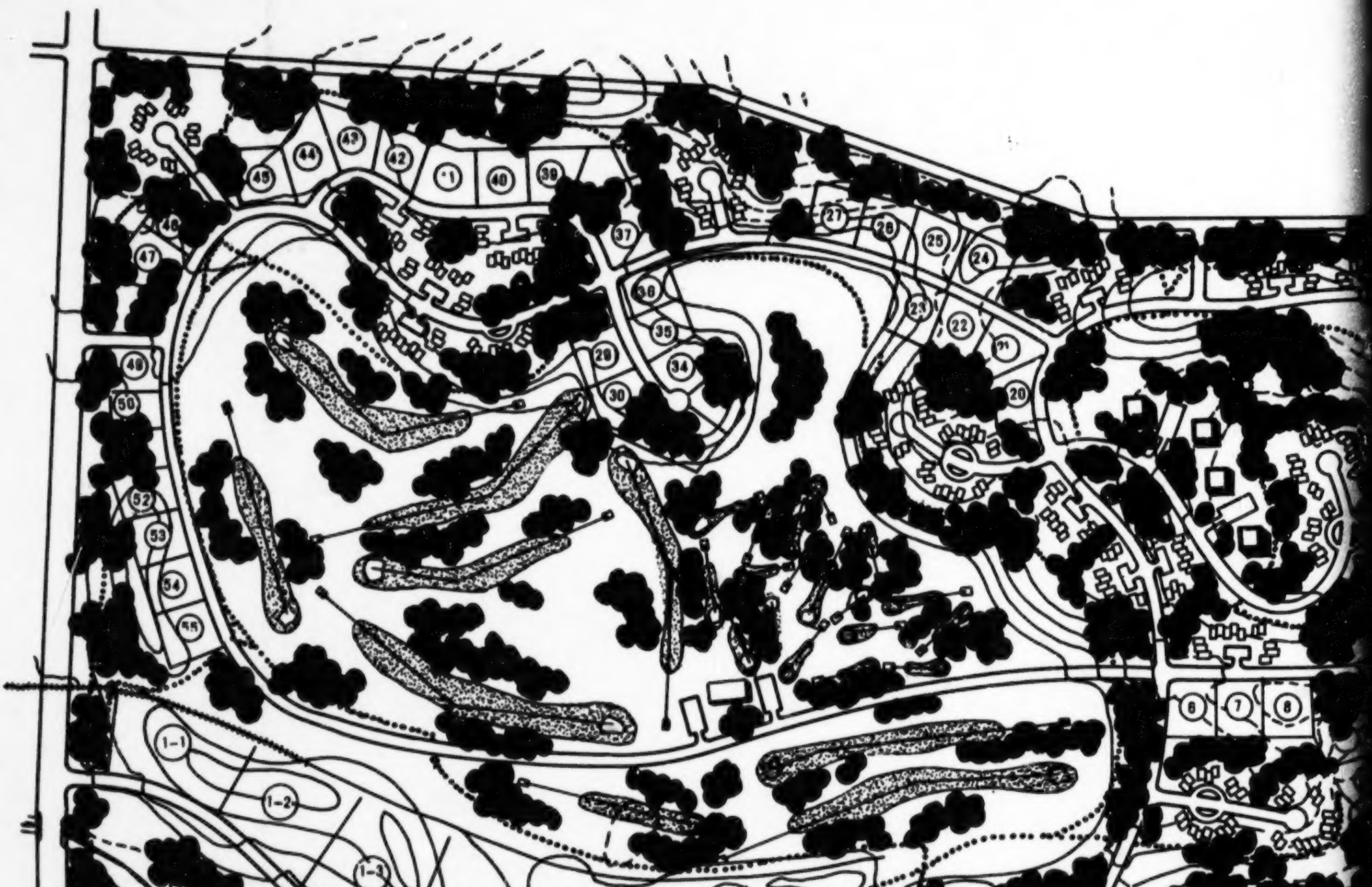
DATE: OCTOBER, 1969

B

SCALE IN FEET EXCEPT AS NOTED

200 100 0 200 400 600 800 1000

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965


45
44
43
42
41
40
39
46
47
37
27
26
25
24
36
35
34
29
30
23
22
21
20
48
50
52
53
54
55
1-1
1-2
1-3
1-4
1-5
6
7
8
5
3
2
1

MAP 30

MAP 30

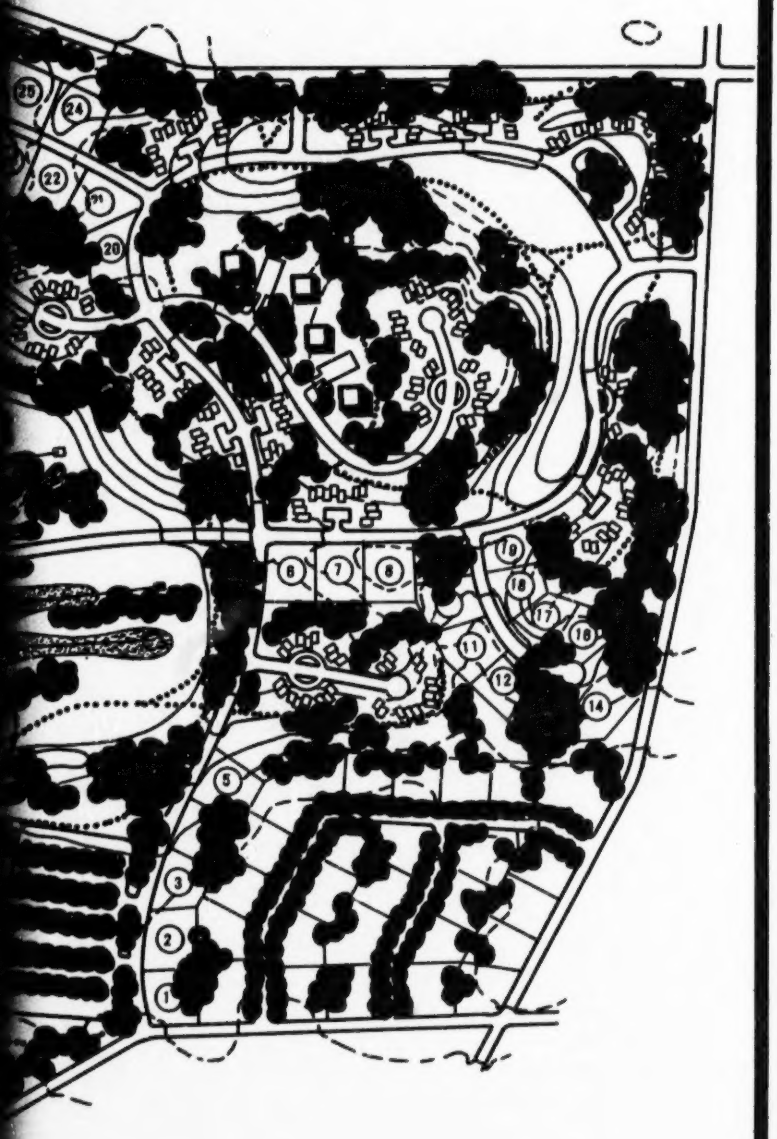
NEW YORK STATE DEPARTMENT OF HEALTH

PROPOSED

ULTIMATE DEVELOPMENT

1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY



LEGEND

RESIDENTIAL

- ONE-FAMILY
- MULTIPLE-FAMILY
- COMMUNITY SHOPPING
- ☐ INDUSTRIAL PARK
- COMMUNITY RECREATION
- ▨ WATER RESOURCES
- .... PEDESTRIAN PATHWAYS

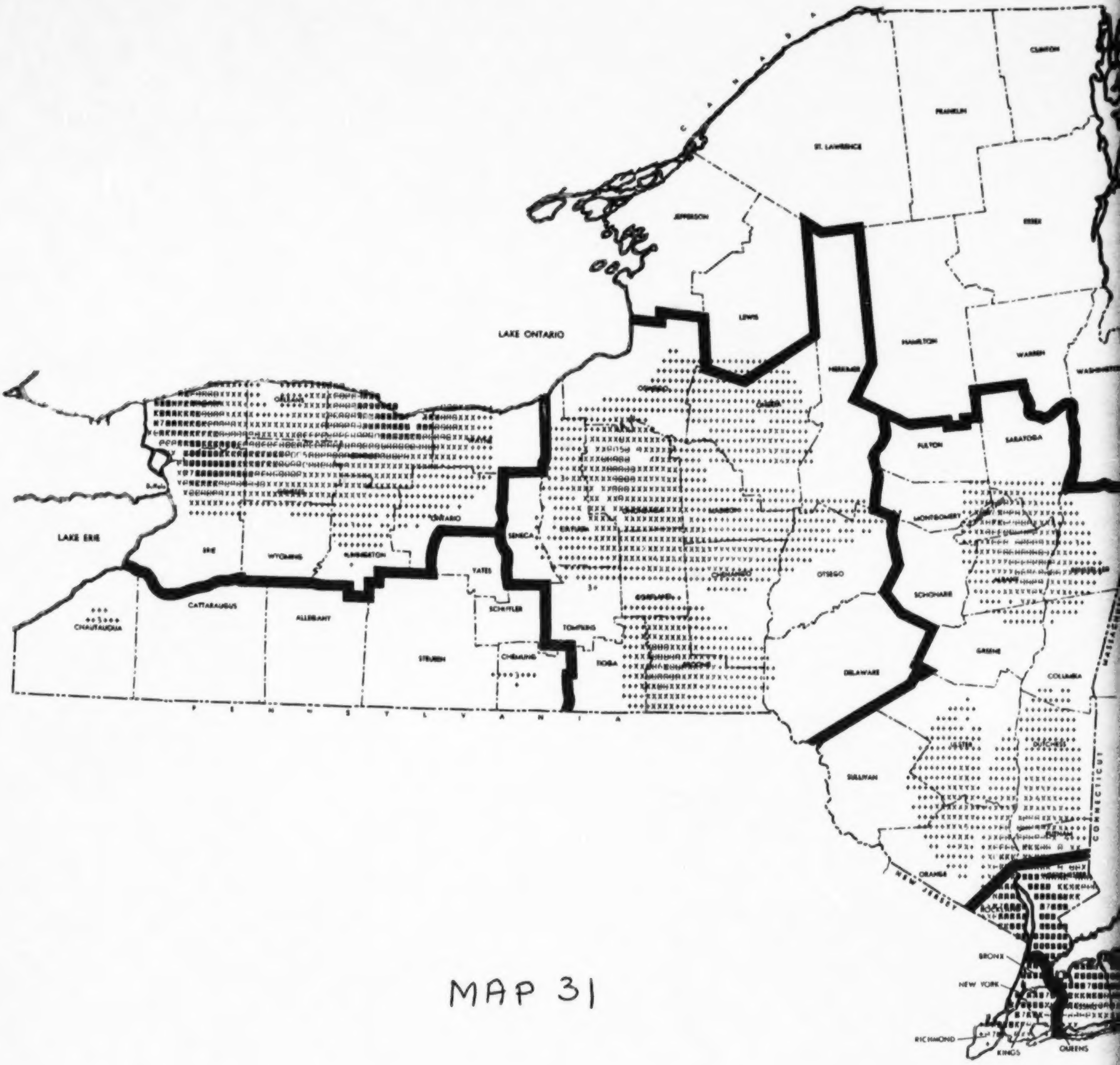
SOURCE: CONSULTANT'S ANALYSIS

DATE: OCTOBER, 1969

SCALE IN FEET

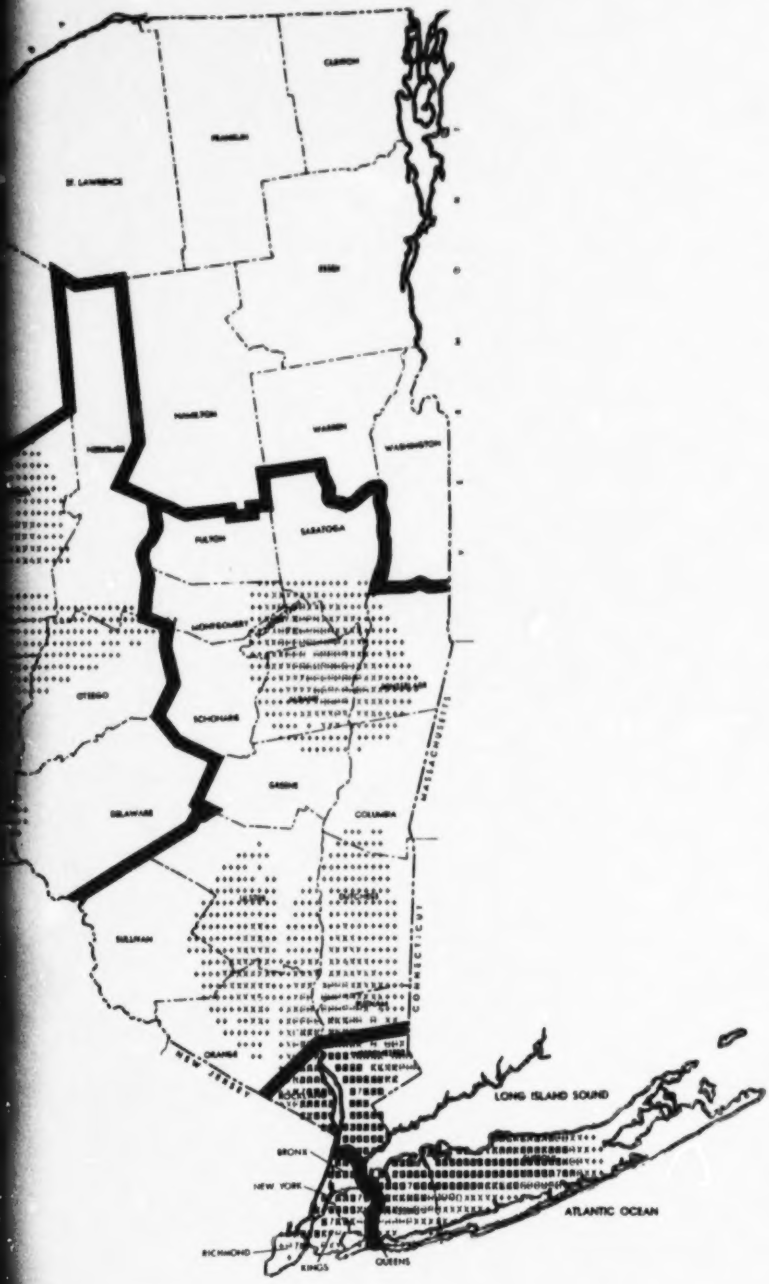
200 100 0 200 400 600 800 1000

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965


CANADA
ST. LAWRENCE
FRANKLIN
CLINTON
JEFFERSON
ESSEX
LEWIS
HAMILTON
WARREN
WASHINGTON
LAKE ONTARIO
OSWEGO
ONEIDA
HERKIMER
FULTON
SARATOGA
ORLEANS
GENESEE
ONTARIO
LIVINGSTON
WYOMING
ERIE
LAKE ERIE
SENECA
CAYUGA
MADISON
CHENANGO
OTSEGO
MONTGOMERY
SCHOHARIE
ALBANY
YATES
CATTARAUGUS
CHAUTAUQUA
ALLEGANY
STEUBEN
CHEMUNG
TOMPKINS
CORTLAND
TIOGA
BROOME
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NEW JERSEY
CONNECTICUT
PENNSYLVANIA

MAP 31

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
WARREN
WASHINGTON
FULTON
SARATOGA
MONTGOMERY
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
GREENE
COLUMBIA
DELAWARE
MASSACHUSETTS
ULSTER
DUTCHESS
SULLIVAN
CONNECTICUT
ORANGE
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 31

NEW YORK STATE DEPARTMENT OF HEALTH

SERVICE AREAS
1995

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

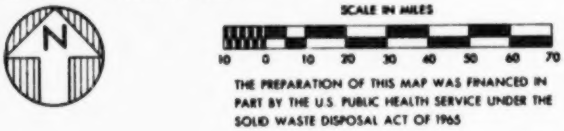
MUNICIPAL AND INDUSTRIAL WASTE DENSITY

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1,2		105	0.0 — 400.0
3	░	9	400.1 — 800.0
4	░	8	800.1 — 1200.0
5	▒	3	1200.1 — 1600.0
6	▓	3	1600.1 — 2000.0
7	█	12	2000.1 AND OVER

SERVICE AREAS

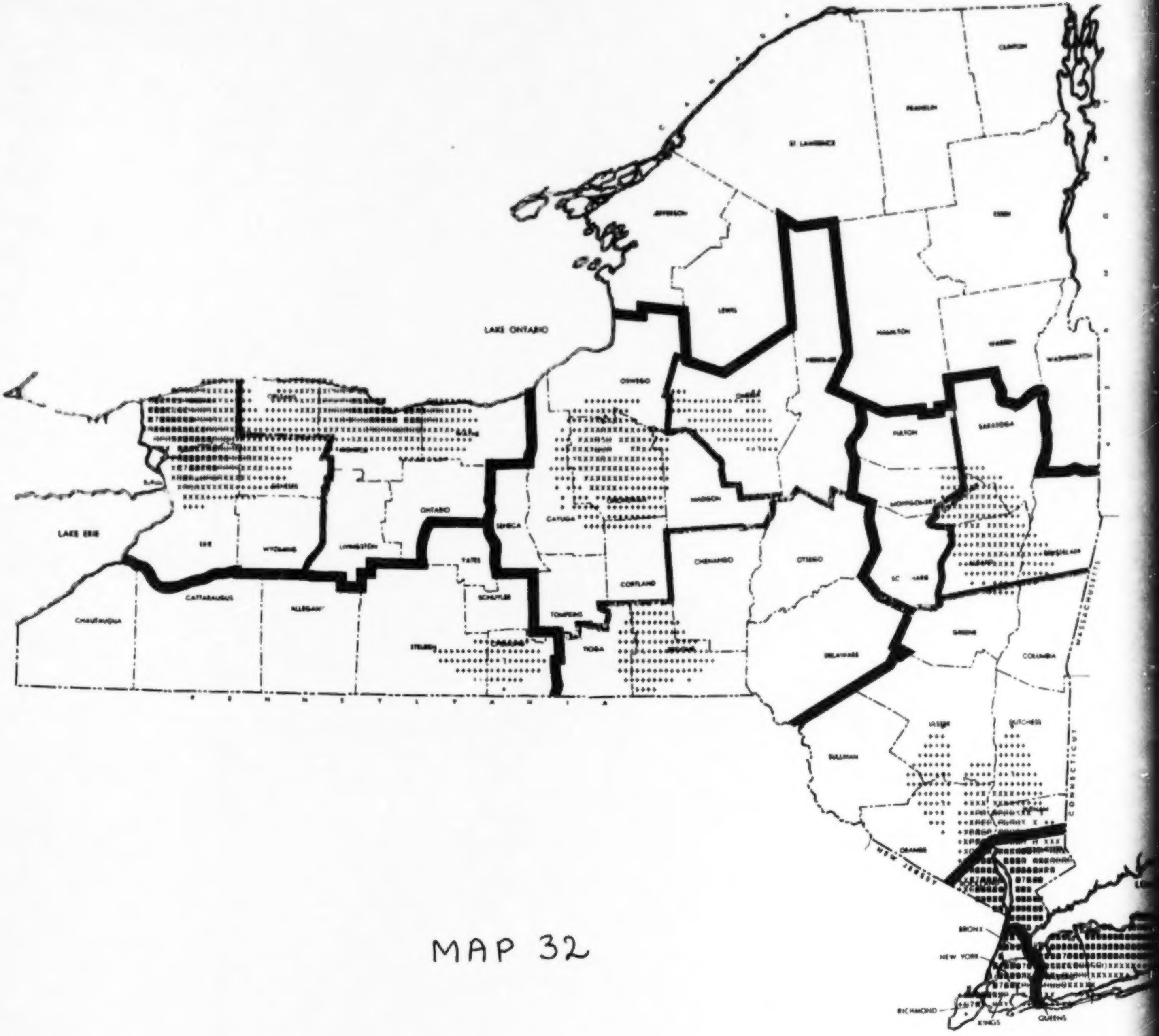
▬ ULTIMATE BOUNDARY

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969


N
SCALE IN MILES
10
0
10
20
30
40
50
60
70

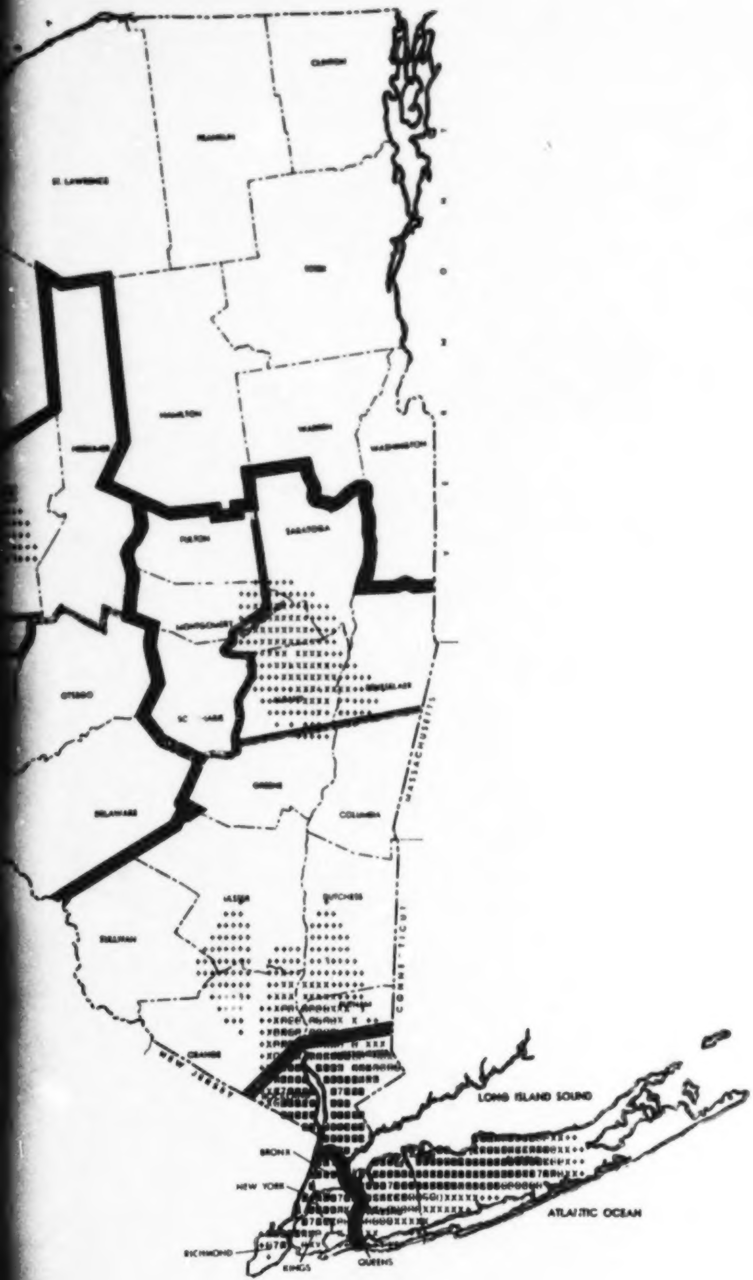
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
CLINTON
FRANKLIN
ST LAWRENCE
ESSEX
JEFFERSON
LEWIS
HAMILTON
WARREN
WASHINGTON
OSWEGO
FULTON
SARATOGA
MONTGOMERY
SC HARIE
ALBANY
RENSSELAER
GREENE
COLUMBIA
OTSEGO
DELAWARE
CHENANGO
MADISON
CORTLAND
TOMPKINS
TIOGA
CAYUGA
SENECA
YATES
SCHUYLER
STEUBEN
ONTARIO
LIVINGSTON
WYOMING
GENESEE
ERIE
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
ULSTER
DUTCHESS
SULLIVAN
ORANGE
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
PENNSYLVANIA

MAP 32

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
WARREN
WASHINGTON
HERKIMER
FULTON
SARATOGA
MONTGOMERY
SCHOHARIE
RENSSELAER
OTSEGO
GREENE
COLUMBIA
MASSACHUSETTS
DELAWARE
ULSTER
DUTCHESS
SULLIVAN
CONNECTICUT
ORANGE
NEW JERSEY
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 32

NEW YORK STATE DEPARTMENT OF HEALTH

SERVICE AREAS

1985

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

MUNICIPAL AND INDUSTRIAL WASTE DENSITY

LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1,2		114	0.0 — 400.0
3	░	10	400.1 — 800.0
4	░	2	800.1 — 1200.0
5	▒	2	1200.1 — 1600.0
6	▓	0	1600.1 — 2000.0
7	█	12	2000.1 AND OVER

SERVICE AREAS

▬ ULTIMATE BOUNDARY

━ INTERMEDIATE BOUNDARY

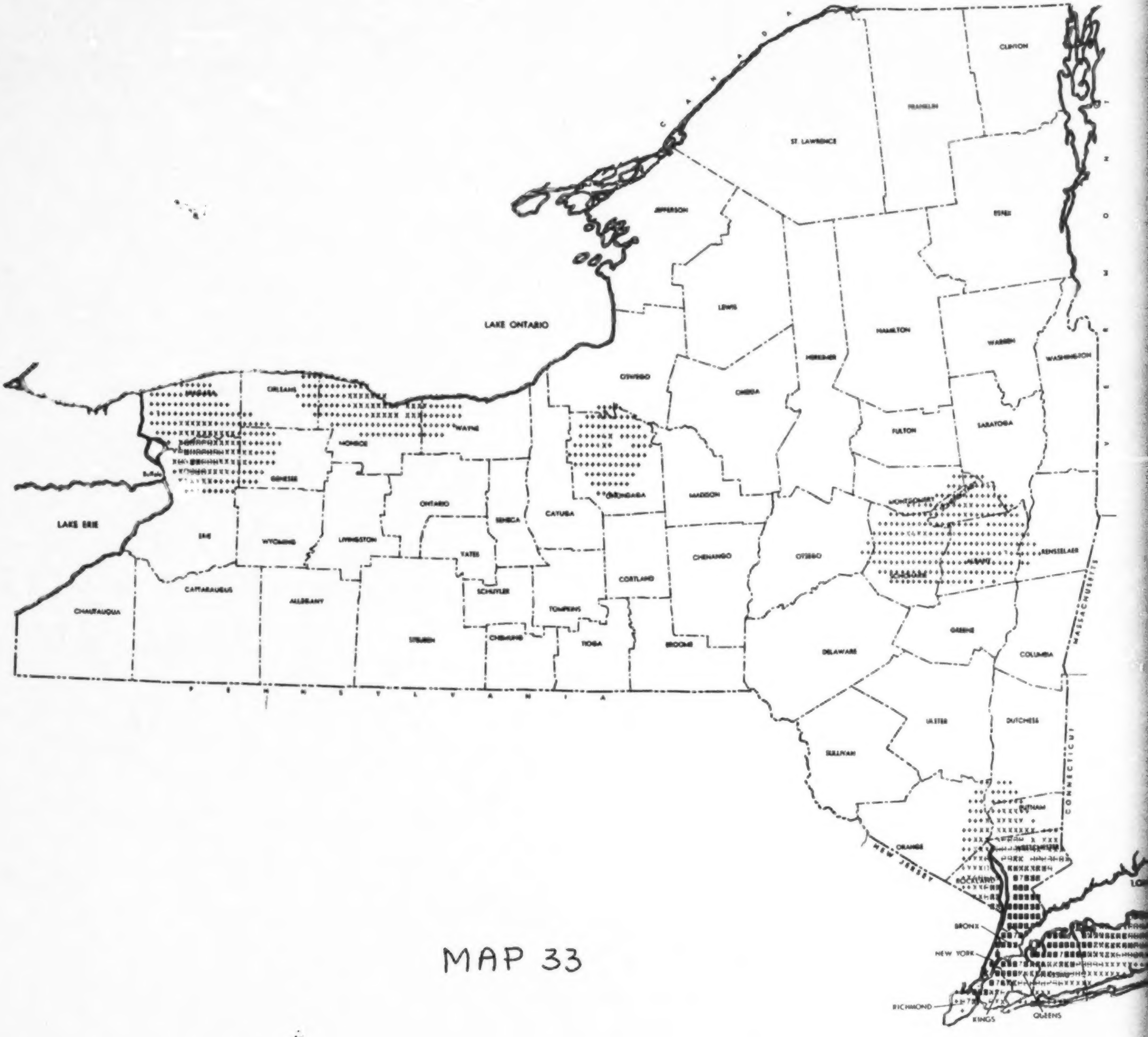
SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

N

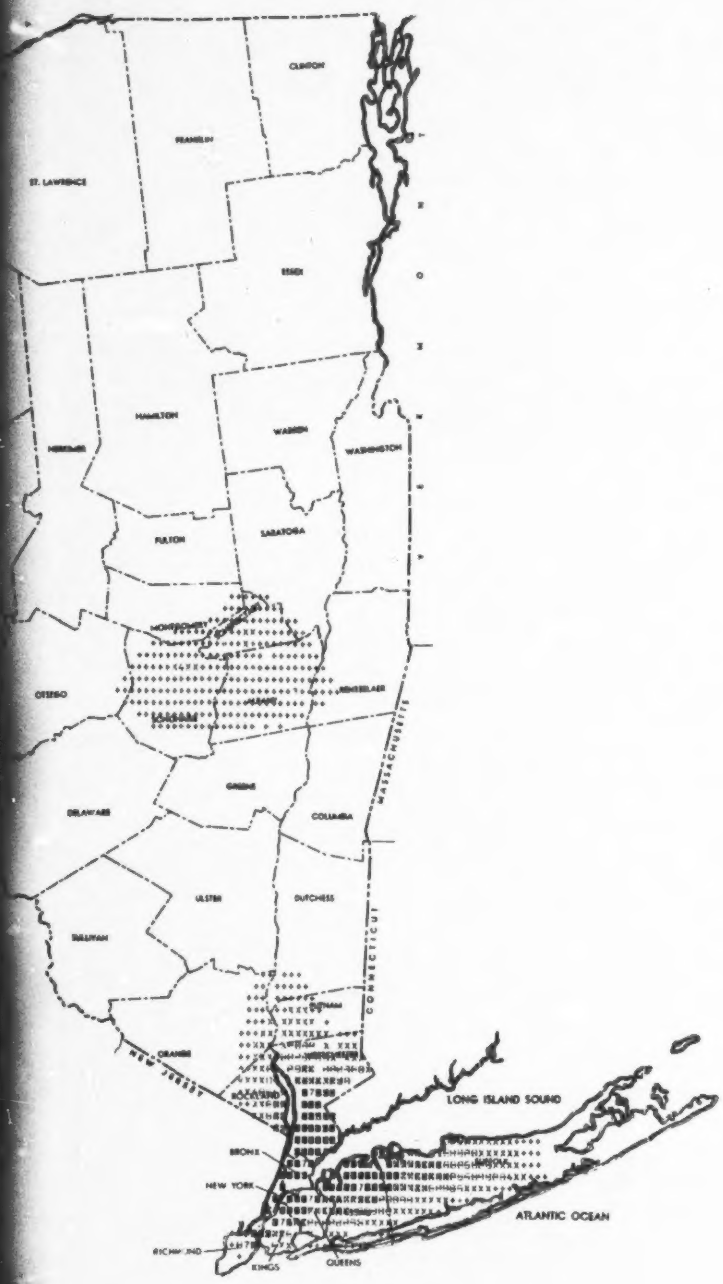
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


CANADA
LAKE ONTARIO
LAKE ERIE
Buffalo
CLINTON
FRANKLIN
ST. LAWRENCE
JEFFERSON
ESSEX
LEWIS
HAMILTON
WARREN
WASHINGTON
HERKIMER
OSWEGO
ONEIDA
FULTON
SARATOGA
NIAGARA
ORLEANS
MONROE
WAYNE
GENESEE
ONONDAGA
MADISON
MONTGOMERY
SCHENECTADY
ERIE
WYOMING
LIVINGSTON
ONTARIO
SENECA
CAYUGA
YATES
CORTLAND
CHENANGO
OTSEGO
ALBANY
RENSSELAER
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
SCHUYLER
TOMPKINS
CHEMUNG
TIOGA
BROOME
DELAWARE
SCHOHARIE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
RICHMOND
KINGS
QUEENS
NASSAU
PENNSYLVANIA
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
VERMONT

MAP 33

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
HERKIMER
WARREN
WASHINGTON
FULTON
SARATOGA
MONTGOMERY
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
GREENE
DELAWARE
COLUMBIA
MASSACHUSETTS
ULSTER
DUTCHESS
SULLIVAN
CONNECTICUT
PUTNAM
ORANGE
NEW JERSEY
ROCKLAND
LONG ISLAND SOUND
BRONX
NEW YORK
ATLANTIC OCEAN
RICHMOND
KINGS
QUEENS

MAP 33

NEW YORK STATE DEPARTMENT OF HEALTH

MUNICIPAL & INDUSTRIAL WASTE DENSITY 1970

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

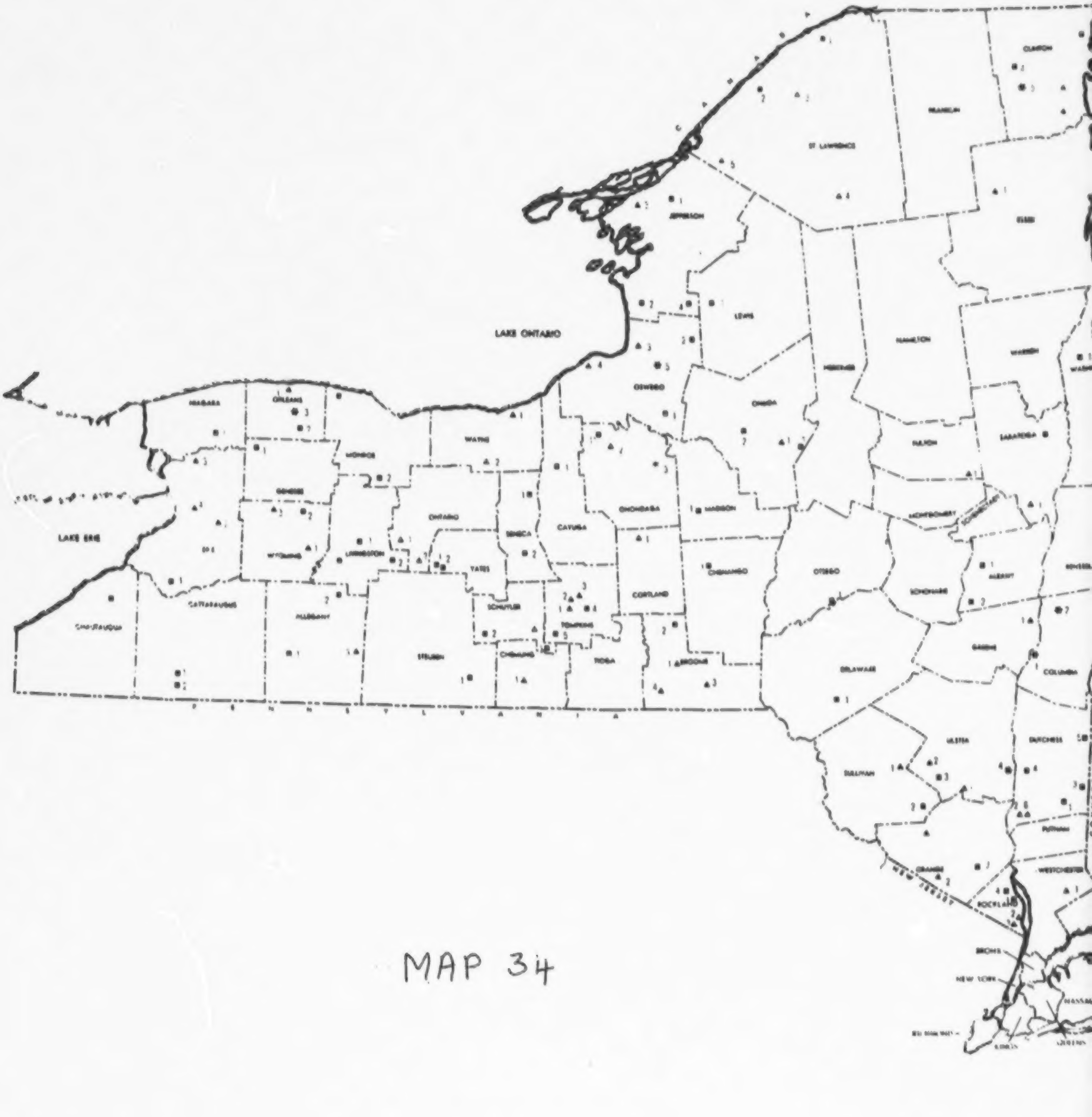
LEVEL	SYMBOL	FREQUENCY	TONS/YR./SQ. MI.
1,2		124	0.0 — 400.0
3	∙∙∙	2	400.1 — 800.0
4	xxx	5	800.1 — 1200.0
5	▤	1	1200.1 — 1600.0
6	✖✖✖	1	1600.1 — 2000.0
7	■■■	7	2000.1 AND OVER

SOURCE: CONSULTANT'S ANALYSIS
DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

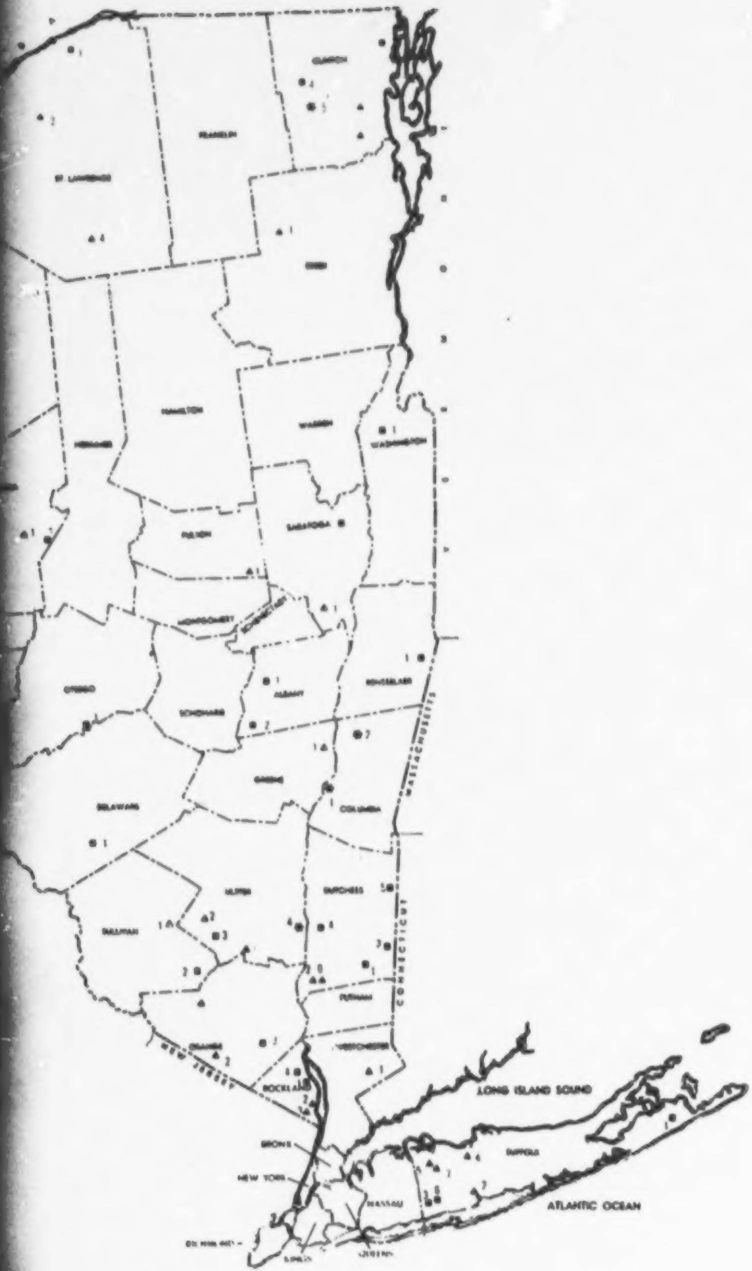
THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B


LAKE ONTARIO
LAKE ERIE
CLINTON
FRANKLIN
ST LAWRENCE
ESSEX
JEFFERSON
LEWIS
HAMILTON
WARREN
OSWEGO
ONEIDA
HERKIMER
FULTON
SARATOGA
NIAGARA
ORLEANS
MONROE
WAYNE
GENESEE
ONTARIO
SENECA
CAYUGA
ONONDAGA
MADISON
MONTGOMERY
SCHENECTADY
ERIE
WYOMING
LIVINGSTON
YATES
CORTLAND
CHENANGO
OTSEGO
SCHOHARIE
ALBANY
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
SCHUYLER
TOMPKINS
CHEMUNG
TIOGA
BROOME
DELAWARE
GREENE
COLUMBIA
ULSTER
DUTCHESS
SULLIVAN
ORANGE
PUTNAM
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
NASSAU
QUEENS
KINGS
PENNSYLVANIA
NEW JERSEY

MAP 34

A


CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
HAMILTON
HERKIMER
WARREN
WASHINGTON
FULTON
SARATOGA
MONTGOMERY
SCHENECTADY
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
GREENE
COLUMBIA
DELAWARE
ULSTER
DUTCHESS
SULLIVAN
PUTNAM
ORANGE
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
NASSAU
SUFFOLK
QUEENS
KINGS
NEW JERSEY
CONNECTICUT
MASSACHUSETTS
LONG ISLAND SOUND
ATLANTIC OCEAN

μσ 530

MAP 34

NEW YORK STATE DEPARTMENT OF HEALTH

SELECTED STATE OWNED LANDS

STATEWIDE COMPREHENSIVE
SOLID WASTE MANAGEMENT STUDY

LEGEND

✱	200 - 500 ACRES
▲	500 - 1000 ACRES
■	1000 ACRES AND OVER

SOURCE: RECORDS AND INVESTIGATIONS OF THE NEW YORK STATE DEPARTMENT OF HEALTH

DATE: AUGUST, 1969

SCALE IN MILES
10 0 10 20 30 40 50 60 70

THE PREPARATION OF THIS MAP WAS FINANCED IN PART BY THE U.S. PUBLIC HEALTH SERVICE UNDER THE SOLID WASTE DISPOSAL ACT OF 1965

B